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FLYING BLIND—A STUDY IN THE PHYSIOLOGY OF THE VIIIth NERVE.

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To fly "blind" used to be extremely hazardous. It need not be so today. Any good pilot who understands his vestibular sense, and who is taught to fly blind, can now do so with complete safety.

Today we fly by instruments of precision. Tomorrow by the Robot. Consequently, flying becomes safer and safer as the years roll on.

These precision instruments are accurate and dependable. But, although the instruments do give the pilot definite information, his vestibular sense gives him contradictory information. The instruments tell him one thing, but he "feels" another thing. Therefore, the pilot's difficulty today lies in his attempt to reconcile what the instruments tell him and what he "feels." It is a very simple problem with a simple answer. Any pilot can understand the essentials of his vestibular sense after one-half hour's instruction by a flight surgeon. In our opinion, a regulation or a law should require every pilot, either military or commercial, to receive this instruction. We also feel that the earlier he receives this instruction, the better. The ideal would be that any student pilot be taught to

fly blind, before he has any of the usual flying instruction. The beginner has no difficulty in learning blind flying; the veteran pilot has great difficulty. Such instruction in the vestibular sense by a flight surgeon is the very basis for training in flying blind. This is a serious matter; Kingsford-Smith told us personally that if he had not had our instruction in the "turning chair, with the instrument box," he would never have reached Australia. He said, "I would have spun down into a very large ocean."

The writers think it is lamentable to hear it said that this is a subject which needs the most profound research and experimental work. It has all been done long ago. If there be any subject that is thoroughly known and mastered, it is blind flying. As to the physiology of the ears themselves, we knew as much in 1917 as we do to-day.* Then, of course, we did not have the instruments of precision.

In May, 1917, the writers first began their study of flying blind. Separately, and frequently together, one a pilot and the other a flight surgeon, they have continued their study of this problem until the present date. Among those who have made outstanding contributions to this study are Major Eugene G. Reinartz, Flight Surgeon; Lieutenant Carl J. Crane, Pilot; and David A. Myers, Flight Surgeon. These are officers in the Army Air Corps; in the Navy, Dr. William L. Mann; in civilian life, Captain G. Allen Hancock was the first to give regular instruction as presented in this paper, in the Hancock School of Aeronautics; and the Pan American Airways was the first commercial organization to adopt these methods.

In the beginning of our study, we had two crude little "pusher planes" and 20 flying cadets at Essington, Pa. There was a similar effort at Mineola, Long Island; another at North Island, San Diego. That was about all there was to the Air Service at that time.

The late General Theodore C. Lyster, and those of us who came to work under him, when he originally created "Aviation Medicine," had no previous experience to guide us — there were almost no books of reference or other literature; however, in our attempt to understand the relation of the pilot

*The book, "Equilibrium and Vertigo," by Isaac H. Jones, was published by J. B. Lippincott Co. in 1918.

himself to flying, we did have certain convictions. We realized that Nature never intended that man should fly at all — that, from the instant the flyer leaves the ground until his return, he is operating under unnatural conditions. In the air, he is whirled about in every conceivable manner, as he never could be on land or sea; and when he ascends to higher altitudes, he is deprived of the normal amount of oxygen. We realized that flying, more than any other activity, would make the most exacting demands upon the eye, the nervous and cardio-

Fig. 1. Instrument panel of the latest Douglas plane, showing all of the instruments of precision mentioned in this paper.

vascular systems. But, even in the beginning, we sensed that the essentially *new* problems in aviation were those of:

1. The "vestibular sense" — whirling, air-sickness and blind flying; and

2. The problems of oxygen-want.

Considerable information was available about the oxygen problem; for many years physiologists had made precise studies in the effects of altitude, on high mountain peaks and in

balloon ascensions. However, in the problem of whirling and blind flying, we had nothing whatever to guide us. We did know, of course, that this was an ear problem; that the vestibular mechanism of the aviator should not be unduly hypoactive or hyperactive, and we realized that the vestibular portion of the internal ear and its intracranial connections had a greater importance in aviation than in any other human activity. But we did not know, until later in our experience, how vital it is for the aviator to understand these little organs which, even to this day, so few pilots realize are hidden away in their skulls.

In the early days, one waited until the wind died down before "going up" — usually about 5 p. m., or about sunup. Our pusher planes were barely able to maintain flying speed. It never occurred to anyone to attempt to fly in bad weather; consequently we did not at first have much opportunity to study the problem of flying blind. At that time all we knew was that the ear had a unique importance in flying.

Before we had any practical experience, we even had the hope that the otoliths of the utricle and the saccule might enable the pilot, in a fog, to determine whether he was right-side-up or up-side-down. This was a forlorn hope and we soon realized that neither the ear, nor any other organ, can orient the pilot when he is flying blind. But we have come to learn that the ears are far more important to flying than we had dreamed at that time.

Like the eye, the ear can give us correct information and it can also give us incorrect information — illusions. Before considering the illusions, we will first consider what correct information the ear gives to the pilot.

In the sensing of motion, the ear has an advantage over the other senses during flight. As Colonel Eugene R. Lewis expressed it, the composite of general motion-sensing is made up of the visual sense; the proprioceptors, including muscle, joint, splanchnic and visceral sense — all grouped for convenience under the term, "deep sensibility"; the tactile sense; and the vestibular sense. When we consider each of these senses separately, we realize that the vestibular sense is the only one that has an unimpaired usefulness in the air. The motion-sensing of deep sensibility in the air does not relate itself to the surface of the earth but to the evolutions of the

plane. For example, one is pressed more firmly against the seat when at the top of a "loop" than when one is flying straight. Vision, so important in sensing motion on the ground, suffers some impairment of its usefulness in the air because the pilot is so far removed from the details of visible objects. When darkness, or cloud or fog, further reduces the usefulness of vision, this sense becomes partly or completely eliminated as a source of guiding information. The tactile

Fig. 2. Simplest form of instrument box on turning chair. The tube at the end of the bank-and-turn indicator enables the flight surgeon to pump air into the instrument, before the turning tests are made. When the air is pumped in, a gyroscopic top is set into motion. (In the airplane, the rush of air is provided by a tube facing the direction of flight.)

sense is relatively unimportant in motion-sensing, either on the ground or in the air. But the vestibular sense suffers no depreciation in the air as compared with on the ground. The sole function of the vestibular sense is that of the sensing of motion.

During the war, studies were made in the attempt to determine the relative contribution of the various senses to flying. Experiments were made under the direction of Dr.

Eugene R. Lewis, Dr. Henry Horn, Dr. Lewis Fisher, one of the writers, and our associates in the Medical Research Laboratory.

One series of tests, in the detection of linear motion, was conducted by Dr. Lewis. Four groups were selected: Normals; deaf-mutes with vestibular function; deaf-mutes with no vestibular function; and tabetics with impairment of deep sensibility. These individuals were taken up and down in elevators that made a trip of 40 stories, a height of 400 feet, at a maximal speed of 1,000 feet per minute. The elevator shafts and the individuals were in the dark, so that no information could be obtained by vision. Tactile impulses were eliminated by lining the entire car with thick blankets. Therefore, with vision and the tactile sense eliminated, there remained only the vestibular sense and the "deep sensibility." Dr. Lewis reported the following conclusions:

1. Normal individuals; the deaf-mutes with good vestibular function; and tabetics with good vestibular function — all were sensitive to acceleration, either upward or downward.

2. At a sustained rate of speed, perception of motion in a linear direction was sensed accurately by each group except those lacking deep sensibility.

3. During retardation, perception of motion in a linear direction was sensed accurately by those with good vestibular function.

4. During retardation, the deaf-mutes with no vestibular function were unable to detect the character of the motion. They were aware that they were subjected to some kind of motion, but could not determine whether it was upward or downward.

5. Arrest of motion was most accurately detected by the group lacking vestibular function but in possession of unimpaired deep sensibility.

In general, the tests indicated that deep sensibility could inform the individual that he was moving; but that the direction of the motion was determined by the vestibular sense.

At that time, the same group of otolaryngologists conducted another experimental study on the "feel of the ship." Prolonged studies were made in actual flights. Those with nor-

mal vestibular sense, were compared with deaf-mutes that had no vestibular function. Those with normal vestibular sense, when blindfolded were accurate in their detection of motion during those flights. The blindfolded deaf-mutes were not.

Seven deaf-mutes were tested. The striking difference between these deaf-mutes and the normal individuals was not only evident in the first tests. There was a still more striking lack of improvement in all their subsequent flights. The flight surgeons and pilots who conducted these experiments were impressed with the importance of the vestibular apparatus in detecting motion in actual flight. It was evident that very

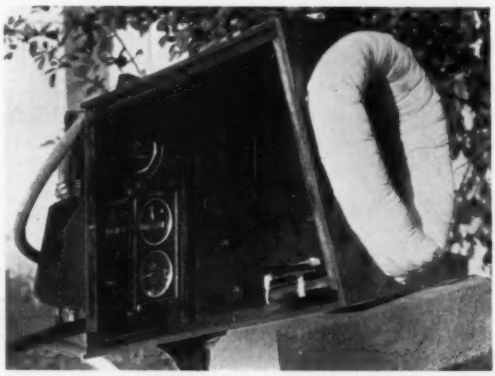

Fig. 3. The side of the instrument box has been removed. Note the flashlight facing the instruments.

little can be expected from deep sensibility when it alone is relied on to detect motion. The seven deaf-mutes were all intelligent, highly interested and keenly aware of the meaning of the experiments. Some of them had felt convinced that they would be able to qualify for flying. After the tests were made, their charts were shown to them and they were much chagrined. Their guesses as to the kind of motion to which they had been subjected were of the wildest character. Sudden nose dives and sudden upward movements were carried out at such acute angles that it seemed remarkable that they guessed as inaccurately as they did. They admitted that they felt "entirely in the dark." They had to struggle against the

impulse to tear the bandage from their eyes. In other words, they were completely lost in space. We felt a great respect for them, in that they were willing to subject themselves repeatedly to such trying experiences.

As a result of these studies, we realized that one who shows good responses in the turning chair shows good detection of motion in the air; and that one who shows poor responses in the turning chair shows poor detection of motion in the air. As we then expressed it, "There is this direct relation between the chair and the air, and the air and the chair."

To this day, most aviators still think that it is a "weakness" if they experience "dizziness," nausea, or any other vestibular response, either in the turning chair or in the air. There are also some physicians who have thought that the safest aviators would be those who lack vestibular function; that they would be incapable of having motion-sensing illusions, which normal persons feel after spinning nose dives and other whirling maneuvers. This seems to us to be a superficial observation. All normal sensory end-organs are capable of producing illusions; but surely the aviator needs all the information that he can get from all of his end-organs. He needs, first of all, normal senses, including the vestibular sense. He then needs the education of all his senses, including his vestibular sense. Any normal individual can acquire such an adjustment to his vestibular sense, in seasickness, in whirling dances, in acrobatics, or in any other activity involving motion-sensing. He simply learns to interpret the unusual vestibular impulses. Whirling artists may show full normal response to vestibular tests; their art lies in the education, experience and dexterity which they have acquired by repeated performance. A whirling dance may be well performed by a novice; but the expert whirling dancer can suddenly stop still without falling, whereas the novice falls, simply because he has not attained experience. The difference between the artist and the novice lies in the artist's ability to place the proper construction upon his false sense of motion.

After the war one of the writers was still intrigued by this fascinating subject; and in 1921 he interested two neurologists to work with him — Dr. Samuel D. Ingham and Dr. I. Leon Myers. It occurred to us that one of the most remarkable feats of equilibration is performed by the cat, when he

falls in the air. He is peculiarly adept in righting himself and always landing on his feet. The question was, "Why and how does a cat turn over?" In the effort to determine what precise contribution is made by each organ concerned in motion-sensing we thought that a precise analysis might be made by experimental work on cats and dogs.

Mr. Thomas Ince made this work possible. He gave us what commercially would correspond to $10,000 worth of slow-motion photography — as a gift to the American Otological Society. In brief, we dropped cats and dogs and analyzed their movements from the moment they were dropped until they landed on a soft mat.

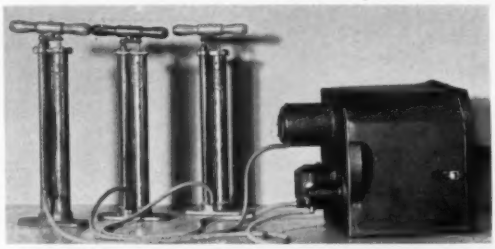

Fig. 4. Pumps for the instruments. After the instruments are started by air pressure, the pumps are detached before the turning tests are made.

Normal cats and dogs were first studied. Experimental animals were then prepared and after their full recovery from the operative work, the tests were repeated. These motion pictures have been shown at various meetings at home and abroad, first before the American Otological Society; but they are reported here in writing, for the first time.

SUMMARY OF FINDINGS.

1. Normal cats, kittens, dogs and puppies. Slow motion analysis: immediately after they were dropped, all cats and kittens turned right-side-up; extended all legs downward with back humped upward; floated downward and landed perfectly. The dogs did the same, only the dogs did not turn so promptly and did not hump the back so much.

2. The same normal animals blindfolded. The cats and kittens turned over just as promptly as with eyes open; humped the back just the same; landed as well, but crawled away with bellies close to the mat.

3. Cats and kittens, whose internal ears had both been destroyed. Eyes open. Did not turn over. On descending, rolled over and over until earth was struck.

4. Same cats and kittens, blindfolded. Same result, except that on landing, crawled off with bellies close to the mat.

5. Cats and kittens with one internal ear destroyed. Better performance than those with both ears destroyed, but not so good as the normal.

6. Cat with one ear destroyed, plus cerebellar hemisphere of the opposite side; cat with one ear destroyed, plus cerebellar hemisphere of the same side. Result: the performance was indeterminate but poor, both in delayed turnings and variable landings.

7. Cats with destruction of one cerebellar hemisphere, without operation on either ear. These cats turned over very well, both with eyes open and blindfolded. Their performance was almost as exact as that of the normal cat.

This outline of experimental work, both during and after the war, gives us a brief resumé of what we have come to know about the contributions of the vestibular sense to accuracy and safety in flying. It is evident that the "feel of the ship," which is the sense-complex that makes for a first class pilot, requires normal vestibular motion-sensing.

We now consider the illusions that come from vestibular impulses, particularly when we are flying blind.

We all originally thought that the airplane was an automobile with wings; that this contrivance simply went up in the air instead of running along on the ground; and that we, relying upon our own senses, could drive it just as we were accustomed to drive an automobile. The change in the attitude of flight surgeons, as well as pilots, during the succeeding months and years, came with experience. We came to realize that the airplane is not an automobile, but a ship — a ship navigating the ocean of the air. And so one of the great rea-

sons for advancement and safety in flying lies in this change in our own mental attitude toward it.

Any overconfident pilot who still feels that he can rely upon himself and his own senses in meeting all the conditions in the air is in danger, and is apt to come to grief. Recently, an ocean liner was approaching San Francisco after four days in a dense fog. The navigator mentioned that within 10 minutes, we should be able to see the red light at the Golden Gate. In five minutes — there was the red light. No navigator of the watery ocean would think of relying upon his own

Fig. 5. Under the hood. The student receiving instruction is placed in the front cockpit. The instructor sits in the rear cockpit. Note that this plane is used only in clear weather, because all the instruments of precision are on the instrument panel in the cockpit under the hood.

senses. He puts his confidence in, and achieves safety by, instruments of precision.

Much time elapsed before instruments of precision were available for the airplane. Through all the early years most aviators felt that their natural instincts were better guides for operating their craft than the best instruments available. Years were required to convince the majority of flyers that their old belief was wrong and the cause of so many fatal crashes. Wilbur and Orville Wright were conspicuous exceptions. They designed the first instrument ever used. It was a string about 8 in. long. This cord was fastened in front of

the pilot with one end swinging free. So long as this string pointed directly at the pilot's nose, the ship was flying without slipping or skidding. This was in 1912. In 1914 they brought out a pendulum bank indicator, and also an accurate angle-of-climb indicator. These two were used in conjunction with the earlier string. But they found it difficult to get even their own student pilots to use these instruments, because of the humiliation experienced when aviators in general would say, "The students of the Wright brothers find it necessary to use instruments in flying." In other words, for many years instruments were not popular and flyers took pride in scorning them.

Until the great war began in 1914, airplanes carried few instruments. These as a rule were crude, and air activity ceased during foggy weather. We believe that the reverse will be true in future wars and that activities will be cut to a minimum during clear weather.

Blind flying had its real beginning in 1918, when Dr. Elmer A. Sperry, noted for the development of the gyroscope, produced a "turn indicator." That year, with the aid of this instrument, one of the writers made a "fog flight" over the Allegheny Mountains, from Washington, D. C., to Ohio, with Major-General William Kenly, then Chief of the Air Service, as a passenger. This turn indicator was described by its gifted inventor as a "crutch" for the magnetic compass.

The modern instruments include the "Artificial Horizon," the Bank-and-Turn Indicator, the Rate of Climb, the Rate of Speed, the Sensitive Altimeter and the Flight Integrator, now being perfected by Crane and Ocker. The name, "Artificial Horizon," has been given by its manufacturer to just one instrument. But it is the combined use of all the instruments that stabilizes the mind of the pilot. Each instrument makes its own contribution. The end-result is that the pilot has a definite conception of his position in relation to the external world. In other words, all of the precision instruments combine to create for the pilot an artificial horizon.

These instruments are so reliable that one would think it a simple matter for anyone to rely upon them and fly safely in any kind of weather. To this day, however, many a pilot is sending his instruments back to the manufacturer to have

them corrected, only to have the instruments returned with the information that they are in perfect condition. In brief, such a pilot cannot interpret his instruments properly, simply because he does not understand himself.

If one analyzes the comparatively few disasters of modern aviation, he cannot fail to be impressed with what has come to be an old story —"bad weather," "fog," "storm"— in brief, blind flying. During the war each crash was investigated by a committee consisting of the commanding officer, the officer in charge of flying and the flight surgeon. All of these crash

Fig. 6. This combined picture shows the sequence of training in blind flying: (a) demonstration to the pilot with the instrument box on the turning chair; and (b) actual flying under the hood. After such training the pilot, when he encounters fog, or any condition under which he cannot see outside, is in command of the situation. All that he needs to do is to look at the instruments. He disregards any illusions — because he has been trained in the turning chair and under the hood.

reports were brought to our desk and the results tabulated. Many of the accidents were caused by structural failure and motor failure. Certain planes burned in the air, and in those days there were no parachutes. In addition, there was an appreciable number of what we even then termed, "ear deaths." There is a great contrast today. Structural defects and motor failure are practically unknown. The "ear deaths" still occur.

We have all had the following experience. In the railroad station, we are sitting at the window of the car and looking out. Suddenly our train starts to go forward; we rush out

to the platform to wave goodby to our friends — but the friends are still there and so is the platform. We were not moving; it was the other train that was coming in, towards us. Immediately we are at our ease. We thoroughly understand the situation. We know where we are and why.

In a fog, after the pilot has rotated in the air and the ship straightens out, his own head is no longer actually turning. But anyone who knows the first thing about the vestibular mechanism, knows why he feels that he is rotating in the opposite direction. In other words, in the railroad station, one has an illusion from his eyes, and now one has an illusion from his ears. He feels that he is going in the opposite direction when he is not. He has vertigo—a sensation of movement contrary to fact. All he neeeds to do is to look at the instruments in front of him and *believe in them.* Immediately he disregards the feeling that he is turning. The sensation in the head of the pilot is exactly the same as when one comes out of the railroad train and looks at the platform. The illusion is gone. He knows the facts of his position.

How shall we train the pilot to understand his vestibular sense? It is very simple. First he is taught with "the Ocker instrument box on the Jones turning chair." Then he is instructed in actual flight "under the hood."*

"The instrument box on the turning chair" is the key to blind flying. The pilot is rotated — preferably in the presence of other pilots. He is turned to the right and then the chair is stopped. He calls out, "I am turning to the left, to the left." He is then turned very rapidly to the right, and then slowly to the right. He may say, "I am not moving," or "I am turning to the left" — whereas all the observers assure him he is still turning to the right.

The pilot is then instructed to look into the instrument box. A flashlight in the box reveals a bank-and-turn indicator and a compass. As he looks at the instruments, he is again rotated. He notes the direction shown by the instruments while he is being rotated. He says, "I am turning right; the indicator also shows I am turning right." When the speed of the chair is slightly reduced, he will say, "The indicator shows I am turning right; my senses tell me that I have stopped" — or

*The reader is referred to the book, "Blind Flight" by Ocker and Crane published in 1932 by the Naylor Co., San Antonio.

"the indicator says that I am turning to the right: but I feel that I am turning to the left."

It frequently happens that the pilot who has just had this demonstration will argue that his sensations are correct. in spite of what the instruments tell him. In that case, it is helpful to have him stand by and watch someone else go through the same performance. As a rule a few such experiences in the turning chair will convince the pilot that he can rely upon the instruments. His thought then is, "Oh yes, I have that feeling of turning, but I am not actually turning." From that moment, his problem is solved.

The next step is actual flight under the hood. Such instruction requires more time, largely because of the element of fear. But after the pilot has mastered flying under the hood. he need no longer have fear and apprehension when he suddenly enters a cloud.

There is one "motion-sensing instrument" that is perfect. It detects motion accurately. It has absolutely no illusions. This instrument is the "robot." It is automatic; unlike the human being, it is not "distressed" by any motion or emotion. The Sperry robot is now used on certain of the air lines; Wiley Post used it on his flight around the world. The George De Besson robot was tested by Captain Hawks; he went up in the air above Los Angeles, set this robot for New York and never touched the controls for nine hours, until he was near the Alleghenies. The attractive feature of the robot is that it is automatic — the human element is eliminated. It is probable that the robot will play a large part in the flying of the future.

A thorough knowledge of the vestibular mechanism has been available to the pilot since 1917. In 1918, one of the writers edited the book, "Air Service Medical," published by the War Department. However, we do not know one pilot who has ever seen this book. Even if they all should read and study it, naturally they would not understand the medical language the book contains. We often wonder why, in some way, the pilots have not become acquainted with at least the simple facts that have been known for such a long time. We venture to say, that to this day, 17 years later, out of 1,000 pilots, there is perhaps only one who even knows that he has a "vestibular apparatus."

We suggest a simple way to tell this story to the pilot:

Remember that just because the eye can fool you, it does not mean that you do not need your eyes. And just because the ear can fool you, it does not mean that you do not need your ears. It is highly desirable that you have good eyes; and in flying, more than in any other occupation, you will be helped by normal motion sensing impulses from your ears. With all of your organs and senses, the nearer you are to a full normal, the better it is for you. You must simply come to understand your ears, not only for the correct information which they give to you, but for the incorrect information which they may give you, when flying blind. When flying in clear weather, the ear helps to give you the "feel of the ship." In a fog, after you come out of a spin, and the ship straightens out, you feel that you are spinning in the opposite direction. But you are not. If you simply look at your instruments and believe in them, you will know the facts of your position. You will realize that your sensations are contrary to fact. In brief, just as the eyes can fool you, so the ears can fool you. But your difficulty is that although you know perfectly well what the eyes are for you do not understand your ears. You think of the ear as the motion-sensing organ that receives impulses from without — what we call "hearing." It is the other part of the internal ear, that senses the motion of your airplane and yourself, that is far more important for you to understand. Your knowledge of this little organ may make the difference to you between safety and disaster. You will be a much better and safer pilot if you study this little "motion detector" in your internal ear.

1930 Wilshire Boulevard.
U. S. A. Air Corps.

CONSERVATISM IN PETROSAL EMPYEMA.*

DR. COLBY HALL, Los Angeles.

The clinical picture of empyema of the petrous apex has become generally recognized and more or less universally agreed upon by most observers; however, when one turns to treatment he encounters many rather confusing reports. It seems, therefore, most imperative that we all give accurate reports of our cases of petrositis stating the type of treatment instituted and the result obtained. If this is done, a survey of the literature in the future will enlighten us as to the proper procedure to follow in each individual case.

Until a recent report by Greenfield[1] the discussion of therapy has been almost wholly confined to surgery of a more or less radical nature once the diagnosis of petrous suppuration has been made. True, there has been an occasional case reported which has cleared up completely with only a simple mastoidectomy, but these have been overshadowed by the emphasis placed upon special surgical procedures. The present report and discussion is most assuredly not designed to discourage these procedures; on the contrary, it is written with the idea of strengthening the conviction that surgery of the apex is necessary in certain cases and with the idea of recognizing the less serious cases so that we can feel safer in awaiting the results of the more conservative measures without endangering the life of the patient.

The symptom complex which has been given us through the tireless efforts of Kopetzky and Almour is: *1.* a suppurative mastoiditis occurring in an extensively pneumatized bone; *2.* a profuse otorrhea which continues or recurs following a satisfactory mastoidectomy; *3.* pain along the ophthalmic division of the trigeminal nerve on the affected side, mainly retro-orbital, *4.* low grade sepsis, and to complete the picture; *5.* Roentgenograms showing destruction of cell walls and coalescence in the petrous apex.

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*From Department of Otolaryngology of Los Angeles Children's Hospital.

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More recently Kopetzky and Almour[2] have further subdivided the cases of petrosal empyema into: *1.* the acute, which run a course ultimately terminating in meningitis unless prompt surgery is done, and *2.* the chronic, which result in a chronic otorrhea. External rectus paresis is not a requisite of either. Retro-orbital pain is a constant feature in the former but may or may not be present in the latter. In their case reports there appears an occasional case which has cleared up without exploring the petrous apex and which has not resulted in a chronic otorrhea.

Case Report: R. W., male, white, age 12 years, admitted to hospital on March 6, 1934. *Chief Complaint*: Head cold, discharging left ear, and fever. *Present Illness*: Onset five weeks prior to admission to the hospital, at which time he had an acute head cold. The left ear began to pain at that time, the drum membrane ruptured spontaneously, and there has been a discharge ever since. The pain subsided and the boy was comfortable until three days before admission to the hospital when he developed earache, increase in temperature, and headache.

Past History: Measles, mumps and chickenpox. The tonsils and the adenoids were removed in 1930. In 1933 he had an otitis media on the left which discharged and was well within three weeks after the myringotomy.

Clinical Course: During the first week in the hospital the low grade fever continued. He complained of intermittent attacks of pain in the left ear, occipital region, and in and about the left eye. This latter was always associated with a very marked drooping of the left upper lid. No neurological abnormalities were found. There was a profuse purulent discharge through a central perforation in the left drum membrane, and tenderness over the mastoid antrum. Roentgenograms of the mastoids revealed both temporal bones to be well pneumatized with an increased density over the left mastoid.

Operation: On March 13, one week after admission, a simple mastoidectomy was performed. The pathology was limited to the antrum and the immediate periantral cells where there was considerable pus, necrotic cell walls, and a thickened discolored mucosal lining. The remainder of the cells were exenterated down to smooth bone but no more remarkable path-

ology was found. The sinus plate appeared normal and no dura was exposed.

Postoperative Course: The postauricular wound remained quite clean and it granulated in satisfactorily, there being no postaural discharge after the drain was removed on the fifth postoperative day. A very profuse purulent discharge contin-

Fig. 1. The cell walls in the extensively pneumatized petrous tip on the right do not show up as clearly here as in the negative. On the left, however, the complete absence of cell walls and the coalescence forming an empyema cavity is clearly evident.

ued from the middle ear. The boy continued to have retro-orbital pain at frequent intervals and this was invariably associated with a partial closure of the left eye. There was an increase in the temperature each day. Neurological examinations repeatedly showed normal findings. Roentgenograms of the petrous tips showed evidence of suppuration of the petrous tip of the left temporal bone with cell necrosis.

The pain disappeared on March 24 and did not return. The temperature gradually subsided, except for a sudden increase on March 23 and 24 due to an acute nasal infection, and reached a normal level on April 3. The mastoid wound was allowed to heal and was completely healed by April 1.

The patient was discharged from the hospital on April 4, and at this time he could hear spoken 44 at six feet and was unable to hear whispered 44 or 77 at any distance with the left ear.

During the first week in May (one month after leaving the hospital) the discharge ceased. Since then there has been no drainage, no pain, no sepsis, and the child seems perfectly well. Examination on September 24, 1934, showed a normal drum and normal hearing.

DISCUSSION.

All of the requisites for a diagnosis of empyema of the petrous apex were present in the above case.

1. Profuse purulent otorrhea. This was present at all times and came from the middle ear through a central perforation in the left ear drum. This emphasizes the point made by Kopetzky and Almour that involvement of the petrous pyramid is a complication of tympanic suppuration and not a complication of mastoid involvement.

2. Recurrent severe attacks of eye pain with partial closure of the eye.

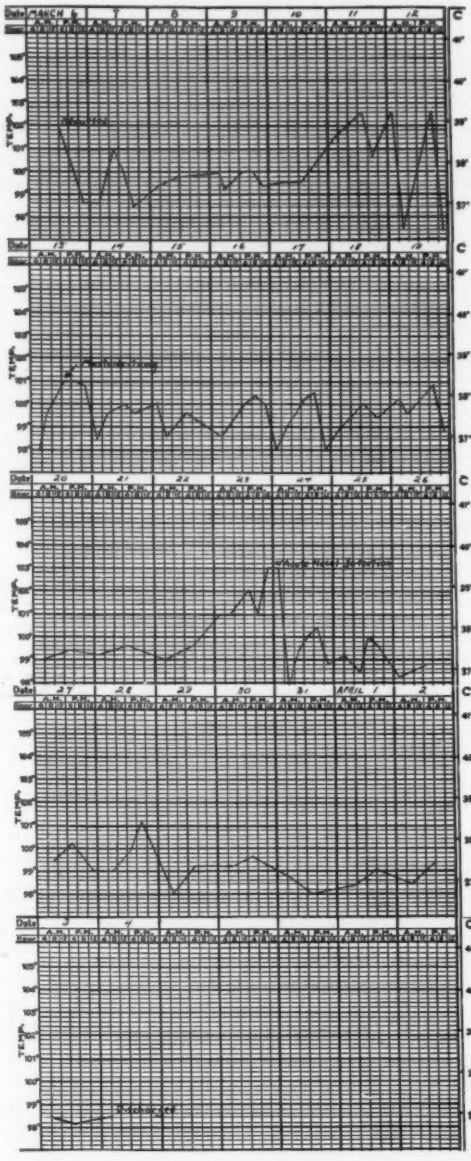
3. Low grade sepsis as noted on the temperature chart.

4. Roentgenograms showing cell necrosis and coalescence in a pneumatized petrous tip.

In this case the pain characteristic of petrous apex involvement was present preoperatively and it should be noted that the otorrhea did not cease after operation until the final healing.

Four periods have been defined, namely: *1.* ocular pain and aural discharge; *2.* low grade sepsis; *3.* period of quiescence, and *4.* onset of meningitis.

In the case described here and in Greenfield's two cases the first three periods occurred but neither meningitis nor chronic



otorrhea have resulted. The child reported here is well, has normal hearing, and has been saved a radical surgical operation.

Greenfield stressed the point that in his two cases the aural discharge was profuse. After a careful study of his cases and of the one reported here it is suggested that the sequence of the disappearance of symptoms into the stage of quiescence is a very important thing. If the discharge is copious and the accompanying symptoms do not become grave it is felt that sufficient petrous drainage is taking place and that we can perhaps procrastinate in safety. However, if the discharge becomes scanty or disappears in the presence of sepsis and pain then surgery is immediately necessary. If, as happened in the case above, the sepsis and pain disappear first and the otorrhea continues it would seem perfectly safe to give the petrous apex a reasonable length of time to subside before resorting to radical surgery. Future consideration of the sequence of symptom disappearance will prove whether it is of value.

CONCLUSIONS.

1. Another case of petrous empyema which was cured without resorting to surgery other than a simple mastoidectomy is reported.

2. The suggestion is offered that the order in which the symptoms disappear may be of significance in the therapy and in the prognosis of petrosal suppuration.

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1136 West 6th Street.

EVALUATION OF SYMPTOMS IN MENINGITIS AND BRAIN ABSCESS.*

DR. MORRIS A. WEINSTEIN, Philadelphia, Pa.

The case we are reporting is that of a male adult, age 55 years, who was brought in to the Mt. Sinai Hospital on July 18, 1934, in a condition of stupor.

The history was obtained from his daughter, who stated that her father was suddenly seized with pain in the chest about 11 days previously, but the pain subsided under medical care after three days' duration. He afterwards developed a severe left-sided headache, with an area of redness, photophobia and lacrimation of the corresponding eye, and for 24 hours prior to his admission to the hospital he was mentally confused and unable to make himself understood, although he apparently recognized his family and was capable of obeying commands.

His past history reveals nothing of any consequence. He enjoyed the reputation of being a healthy and strong individual until two years ago, when he complained of vague precordial pains for several months and shortness of breath. He lived a very quiet life, abstaining from alcohol and tobacco, and raised a family of five children, all of them in good health.

The first medical examination revealed all organs in good functioning condition; a blood pressure of 120/75; urine: straw-colored, slightly cloudy, alkaline reaction, sp. gr., 1015, faint trace of albumin, 1-2 W.B.C., occasional R.B.C., amorph. phos., bacteria and occasional epithelial cells; blood count: Hb., 90 per cent; 4,600,000 R.B.C., 10,200 W.B.C., 71 Pmn., 29 S.M. Mentally, however, he was confused, and the neurological study disclosed some rigidity of the neck, greatly increased reflexes on both sides, bilateral Babinski and Oppenheim, and an abortive left ankle clonus. The spinal tap

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produced a clear fluid, 300 mm., in the erect position under greatly increased pressure.

The provisional medical diagnosis indicated advanced arteriosclerosis, with super-added acute upper respiratory infection, an apparent glaucomatous left eye, an encephalitis of questionable character, because of the presence of motor aphasia, increased reflexes and spasticity in the extremities and muscles of the neck.

On examining his ears, nose and throat the next day we found the following: a moderately deviated nasal septum interfering somewhat with ventilation and drainage, thickened ethmoid capsules, enlarged, cryptic and not actively diseased tonsils, a normal right ear, but a chronically diseased left one. The drum membrane showed an extensive perforation, the remaining rim along the posterior canal wall studded with granulation tissue protruding far into the external canal, and the greatest portion of the ossicles eaten away by necrosis. There was a slight discharge in the external auditory canal, and complete absence of tenderness on pressure over the mastoid region, probably due to sclerosis of the mastoid process.

Taking into consideration the existing irritation of his central nervous system we made the diagnosis of: *a.* Chronic low grade sinusitis; *b.* chronic left otitis media and chronic mastoiditis, and *c.* possible brain abscess?

The otological findings gave this case a new interpretation and direction. We are always impressed by the presence of a frank focus of infection in the system, and we are naturally prone to attribute as many symptoms as possible to this cause. Nevertheless, it requires prudence and unbiased judgment to resist this temptation.

In the light of the localization of the extremely severe headache on the left side, corresponding with his diseased ear, together with the associated sensory, motor and meningeal irritation, the existence of a brain abscess seemed very plausible.

Against this possibility was the very acute onset of the disease, the complete absence of any symptoms pointing to a progressive extension of the ear pathology to adjoining structures, and the comparative infrequency of brain abscess as

compared to sinus complications and meningitis in connection with middle ear diseases.

The X-ray examination on July 19, 1934, disclosed numerous areas of destruction scattered throughout the skull, and increased vessel markings suggesting increased intracranial pressure. The right mastoid appeared normal, the left one sclerosed with several necrosed areas around the antrum, suggesting the possibility of acute exacerbation.

The rigidity of the neck became more marked, likewise the Kernig, while the motor aphasia disappeared, and the spinal tap showed a marked pleocytosis, with increased protein in an A-bacterial fluid.

The diagnosis of a surgical lesion of the left mastoid was considered, and further waiting was deemed inadvisable. A mastoidectomy was urgently advised, with the object in view of searching for an abscess originating in the ear and extending into the brain.

On July 20, a left mastoidectomy was performed, and except for some granulation tissue and softened areas at the tip, around the antrum and the proximal end of the zygomatic process, the rest of the temporal bone was markedly sclerosed, as if Nature had thrown a defense wall against any further spread of the ear infection, and a most careful search for any leads into adjacent structures proved negative.

The effect of this operation on the general condition of the patient was not very impressive. There was an improvement in his speech, but the spastic irritability and Kernig were still as marked as before, likewise the neck rigidity, Babinski and the mental confusion.

The consulting neurologist regarded this syndrome as a reactive or serous meningitis, and as a focal cerebritis in the left hemisphere from an adjacent ear condition.

The same opinion, that of meningitis, was held by the neurosurgeon. He found the patient still delirious and aphasic, with almost normal reflexes, no Babinski, no ankle clonus, and advised sedation and forcing of fluids. As a result, he was inclined more towards waiting for the meningeal symptoms to clear up, which was expected to follow the mastoidectomy.

In spite of all medication along the suggested lines, the patient continued to be restless, to throw himself about in bed, to moan because of pain and to emit inarticulate sounds.

The mastoid wound was healing satisfactorily; the eye-ground examination did not indicate definitely increased intracranial pressure, and a spinal tap still registered 300 mm., cell count showed 400 mostly polys. All cultures were negative.

The general feeling was that the patient still had a localized lesion resulting from a focal infection from the ear, and it was deemed advisable to trephine and tap for an abscess.

A second operation by the neurosurgeon was performed July 24, under avertin and local anesthesia, trephining the left parietal bone, dura appeared normal and under slight tension; the cortex of the brain was moderately engorged. Exploring for an abscess, the cannula met with no resistance when plunged forward at angles of 45° and 30°, nor in the direction downward and posteriorly to the mastoid region, but met a resilient obstruction at a depth of 4 cm., when the cannula was thrust at a 50° angle down towards the mastoid region. Once the needle brought up a clear cerebral fluid when it hit the lateral ventricle.

The following day under the same type of anesthesia the resistant area was re-explored but no pus was found, instead some 8 cc. of cerebrospinal fluid escaped under pressure, with marked reduction in the tenseness of the brain, and resumption of brain pulsation. The exploration of the occipital lobe was fruitless, as was that of the frontal lobe which was opened.

The only pathology encountered was a distended arachnoid which was white and opaque, and on nicking this portion clear spinal fluid escaped. No further attempts were thought advisable and, the wounds were closed in the usual manner and a diagnosis of meningitis and arachnoiditis made.

The immediate reaction of the patient to these operative procedures was a stormy one. He developed convulsive movements, marked spasticity of the extremities which later changed to flaccidity, foaming at the mouth. His pupils were

sluggish, the left dilated and larger than the right. Kernig and rigidity of neck were still present.

Within two days his general condition improved, his sensorium cleared up so that he could recognize his friends, he responded intelligently to questioning and asked for food, mostly liquids.

After a short period of apparent improvement, however, he lapsed into a stupor, and developed signs and symptoms of pneumonia, with all the previous symptoms of CNS irritation returning. He also developed ptosis of the left upper lid. On redressing his mastoid wound which had healed and was clear by this time, we noticed a slight seropurulent discharge from the external auditory canal.

His condition became worse as the days passed and he expired on Sept. 1, 1934, 12 days after his admission and three weeks after the onset of his disease. The spinal fluid was clear all through the disease, and his temperature with the exception of the first few days was high reaching a level between 103-105°.

The post mortem findings were: Tuberculous meningitis with no trace of any abscess cavity in the brain.

The history of this very interesting case, its course, its many changing phases, and the combined effort of all those interested in studying and treating the patient, demonstrate the difficulties encountered at times in diagnosing or ruling out a brain abscess.

The finding of a quiescent chronic otitis media reinforced by such symptoms as headache, motor aphasia, rigidity of the neck, increased reflexes and mental confusion prejudged and clinched the diagnosis of otitic abscess. But all these manifestations of generalized intracranial pressure and to some extent focal localization may also be due to an infectious encephalitis.

An otitic brain abscess must originate by contact infection with a diseased temporal bone. Once the infection has crossed the meninges into the brain substance and induced an abscess, its growth is gradual and takes time, as is the case in chronic affections of the middle or inner ear. During this

latent stage, a number of vague toxemic symptoms may appear, like failing health, slight headaches, loss of appetite, occasional vomiting, vertigo and slight elevation of evening temperature. There is no mention of such a syndrome in the patient's history. Such sudden and acute development fits more the picture of meningitis.

When the abscess becomes manifest these symptoms of toxemia become aggravated; signs of intracranial pressure, due to its increase in size, and injury to vital centers impairing or destroying their function make their appearance.

A quite constant and very important pressure symptom is the slow pulse, below 50; while in meningitis it is usually rapid. Our patient had a pulse rate of 90 on admission and it kept rising, keeping pace with the elevation in temperature. The fever, except for the short period of two days, started at 102°, rose gradually to 104° and 105°, and persisted high in keeping with a septic encephalitis.

Aphasic disturbances are among the first and most frequent dysfunctions, due to destruction of brain tissue in the temporal lobe and the brain tissue adjacent thereto, where the speech center is located, their existence points clearly to an abscess in that region. The patient had motor aphasia (inability to find words to express himself) on admission, but it disappeared the next day and never returned. This symptom could readily be ascribed to the general psychic condition of the patient on account of his toxemia. A real motor aphasia would presume an extensive softening of brain substance, or a collateral edema over a very large area, including both the temporal and frontal lobes.

The changes in the patient's sensorium were of the irritable type, constantly moving to and fro, throwing himself about in bed, trying to sit up, moaning and resentful of pain. In brain abscess, according to many authorities, mental sluggishness, indolence, apathy, somnolence even coma are the predominating symptoms.

Rigidity of the neck is present in brain abscess, but mostly when it affects the posterior fossa, in other words the cerebellum, otherwise it is a symptom of associated meningitis just as the Kernig, and the motor irritation symptoms such as increased reflexes, Babinski and Oppenheim.

Very interesting clues were given by the tapped cerebrospinal fluid. Repeated lumbar punctures before and after the mastoidectomy gave with regularity a clear fluid. It is a settled fact with the Viennese otologic school (Neuman, Alexander, etc.,) although disputed by another authority, that every brain abscess should and does show a turbid liquor.

The cell count varied from 120 to 300, and invariably polynuclears predominating. The preponderance of granulocytes indicates an inflammatory irritation of the pial plexus of the meninges allowing the diapedesis of the leukocytes. The number of cells found in this fluid is pathologic, far below the purulent type of meningitis (in which it may go up to 5000), but in keeping with the tubercular infection of the membranes. Sugar and reducing substances were present in all tappings and furnished no characteristic data.

The chlorides were almost pathognomonic in their significance. Normally they are present in a hypertonic solution, higher than that in the blood stream, 0.72 per cent to 0.75 per cent in the spinal fluid and 0.6 per cent in the blood. Anything that inhibits the exudation of chlorides from the plexus of the brain and its membranes allows the penetration of the relatively hypotonic chloride solution of the blood vessels into the damaged meninges. An increase above 0.75 per cent is met with in uremia and brain abscess, a slight decrease in meningismus, more so in meningitis (0.65 per cent), and the most in tubercular meningitis. The chlorides in the spinal fluid should never fall below that of the blood stream; if it does, it is a bad prognostic sign. Our patient had no increase above, but a lowering below the normal standard, 640 mgm. per 100 cc. Repeated examinations of the spinal fluid for organisms were negative.

We may sum up the picture obtained from the cerebrospinal fluid by stating that it gave a sterile, clear, predominantly polynuclear liquor with diminished chlorides.

These laboratory findings in conjunction with the several contradictory symptoms made the diagnosis of brain abscess, regardless of the alluring discovery of a focus of infection, if not improbable, at least questionable.

In view of the desperate condition of the patient, a "do nothing" policy was out of the question. Therefore, the mas-

toidectomy was performed with the double purpose of clearing up a source of infection and to hunt, with faint hope, for some possible defects in the temporal bone that might have led to the induction of a brain abscess.

SUMMARY.

In analyzing this case we may draw the following conclusions:

1. The diagnosis of brain abscess was made on the strength of two outstanding diagnostic principles: First, based on the theory of focal infection; and the other, on our knowledge of brain localization. But as important as focal infection might be, and as much information as it may yield, to rely on it as sole conclusive clinical evidence would lead us into a diagnostic impasse.

2. Too much significance was attached to the symptoms of "motor aphasia." Anatomically, we should presume a lesion in the frontal lobe; while an otitic abscess presumes damage to the temporal lobe adjacent to the diseased ear, and is the cause of "sensory aphasia." In consequence, we should have expected a very extensive brain lesion of both lobes, with many more clinical symptoms than were actually present. The short-lived motor aphasia might have been due to an enfeebled intellect, in all probability.

3. A detached evaluation of the above mentioned diagnostic elements would have brought out the proper interpretation of the cerebrospinal fluid laboratory findings, and of the clinical symptoms as manifested by the sudden onset, pulse rate, temperature curve and the general psychic behavior.

1309 Spruce Street.

THE MEDICAL ASPECTS OF HEARING CONSERVATION IN THE NEW YORK SCHOOLS.*

DR. EDMUND P. FOWLER, New York.

This is National Hearing Week. It is most appropriate, therefore, that I make at least a preliminary report upon the work being done under CWA Project No. 177, under the direction of Mr. Daniel Caplin, Assistant Director of Health Education. Through the co-operation of Mr. George Chatfield, the school superintendents, most of the otologists, clinics and hospitals, but especially of the New York League for the Hard of Hearing, we have since last spring examined the hearing of over 300,000 children in grades above 3A with the 4A audiometer, and we are in the process of retesting those found with over nine sensation units loss and giving all subsequently found deficient careful 2A audiometer tests and otological examinations.

Eighty-three technicians were trained without cost to the city by the New York League for the Hard of Hearing. Seventy-three teachers were trained in the teaching of lip-reading by the New York League for the Hard of Hearing without cost to the city. Two hundred and twenty-eight teachers in all were trained for this program. Without this service the work would not have been possible.

There have been many hearing tests made in schools throughout the country for the purpose of determining the incidence of deafness, but this is the first time where on a large scale the object has been primarily the prevention and alleviation of deafness, and the conservation of hearing.

The table I display will show you some of the outstanding data and accomplishments to date. I pass around for your perusal the chart I devised for these examinations. These charts are made out in duplicate, one remaining at the school and the other accompanying the child to the outside otologist.

*Read before New York Academy of Medicine, Section on Otolaryngology, Oct. 17, 1934.

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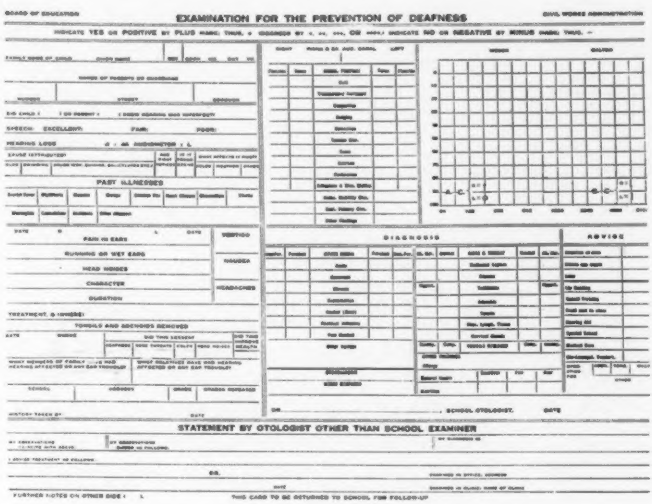
Bear in mind that they are not adapted for use with the usual patients as seen in the office or in the clinic. The chart was designed for the examination of children who would under ordinary circumstances not apply for treatment. However, it is quite complete and has worked out very nicely. The nomenclature under diagnosis may be objected to, but it is the scheme I have used for years in private practice and in the Manhattan Eye, Ear and Throat Hospital, and it at least classifies and clarifies the clinical diagnostic picture better than the older nomenclature. Notice on the bottom of these charts a place to be filled in by the private or clinic otologist so that we may obtain his opinion as to diagnosis and treatment.

With few exceptions everyone concerned has co-operated in this work. There have been one or two hospitals and a few otologists who have refused even to examine the children, some on the ground that the school otologists were being paid and therefore the clinic otologists should be paid for their examinations. Please remember that although the school otologists are being paid a small amount for their services, they are powerless to carry out treatment. This can be done only outside of the schools by otologists to whom the children report for treatment. This is an otological examination for the prevention and care of the diseases causing deafness. Unless treatment or management is given little will be accomplished. We are not aiming simply to accumulate and pigeonhole a mass of statistics. We have sufficient statistics. When the work is finished I intend to carefully tabulate the data from these cards and we will then see which otogolists, which clinics and which hospitals have aided and which have failed to aid in the care and treatment of these deafened children.

On account of the limited number of otologists in the schools, we have to date sent only the more urgent cases to the private otologists or clinics. Those who react adversely to children going to clinics should remember that under ordinary circumstances they would see few, if any, of these children. As it is, we expect before the year is over to send some 15,000 or 20,000 children to otologists for examination, and management or treatment, as the case may be. We believe that a considerable number will be so well taken care of that their hearing and their health will be benefited. To date 2,180 have had careful otological examinations in the

schools and 170 have been seen by outside otologists; 7,528, after 2A audiometer tests, have been recommended for otological examination.

The table gives opposite each disease heading the number of cases in one ear, in two ears, and the total number of cases in each instance. Note particularly that of 674 children tabulated there are 395 without evidence of present or past middle ear suppuration. This is approximately 60 per cent of the number of all the cases tabulated to date. There are 119 cases of chronic discharging ears (18 per cent), and 179 cases of


BOARD OF EDUCATION
EXAMINATION FOR THE PREVENTION OF DEAFNESS
SPEECH: EXCELLENT: FAIR: POOR:
HEARING LOSS
PAST ILLNESSES
PAIN IN EARS
RUNNING OR WET EARS
HEAD NOISES
CHARACTER
DURATION
VERTIGO
NAUSEA
HEADACHES
TREATMENT, & WHERE:
TONSILS AND ADENOIDS REMOVED
DIAGNOSIS
ADVISE
DR. , SCHOOL OTOLOGIST. DATE
STATEMENT BY OTOLOGIST OTHER THAN SCHOOL EXAMINER
FURTHER NOTES ON OTHER SIDE
THIS CARD TO BE RETURNED TO SCHOOL FOR FOLLOW-UP

healed suppurative otitis media, previously diagnosed, previously not diagnosed or residual sclerotic (26 per cent). There are 27 cases of nerve deafness tabulated, which is a lower percentage than found in some other surveys of hearing. The number of foreign bodies is also very small (3). The tabulation under nose and throat findings is interesting, as are also the 191 positive family histories of deafness in these 674 cases. A positive family history was found in 38,545 (12.37 per cent) of the 311,542 tested.

The advising of lip-reading in 371 cases may be thought by some to be excessive. It has been done to insure a better

understanding of language by the pupil, and will be discontinued in instances where subsequent examinations show the hearing to be improved or the prognosis as to progressive deafness to be better. The number so advised *in toto* to date has been 2,502 out of 311,542 tested.

TABLE I.

Otological examinations tabulated to date—674.

EAR DIAGNOSES.

	1 Ear	2 Ears	Total
OMNS, acute	1	5	6
OMNS, chronic	58	303	361
OMNS, past masked	11	17	28
OMS, acute	—	1	1
OMS, chronic	52	67	119
OMS, healed or residual adhesive	66	84	150
OMS, past masked	17	12	29
Nerve deafness	7	20	27
Impacted cerumen	40	40	80
Foreign bodies	3	—	3
Exostoses	1	—	1
Atresia (1 congenital)	4	—	4
Furunculosis	2	—	2
No ear findings	3	8	11

NOSE AND THROAT.

Deviated septa (marked)	73
Sinusitis, and hypertrophied turbinates	217
Hypertrophied tonsils and adenoids	206
Positive family histories	191
Lip-reading advised	371
Re-examination or treated by private physician, otologist or clinics	170

HEARING LOSS 50 S.U. +

	1 Ear	2 Ears
50 S.U. — 59 S.U.	21	4
60 S.U. — 69 S.U.	7	2
70 S.U. — 79 S.U.	15	—
80 S.U. +	8	—

Total otological examinations to Sept. 11, 1934 2,180

After 4A and 2A tests.

My chief concern has been and still is the tendency of many physicians and otologists to belittle the significance of many of the ear conditions shown in the tables. I believe, however, that continued publicity and statistics, particularly concerning the benefits of treatment, will do away with this attitude.

At any rate, we are convinced we are on the right road and in the end we are going to overcome all obstructions and reach our destination—the testing of hearing and the examination, care and treatment of not only school children, but also of preschool children. Our object is prevention! Pre-

TABLE II.

REPORT ON CWA PROJECT No. 177, FEB. 15, 1934, TO OCT. 1, 1934.

Total number of cases examined with 4A audiometer		311,542
Total number of schools tested		284
Total Number with Impaired Hearing Found on Basis of 4A Test (Two Tests):		
1. Impaired hearing, right ear	6.26%	19,503
2. Impaired hearing, left ear	5.31%	16,538
3. Total IHR IHL	11.57%	36,041
4. Impaired hearing, both ears	3.79%	11,817
5. Total IHB IHR IHL	15.36%	47,858
6. Total number of positive histories of ear disease (pathological conditions exclusive of impaired hearing cases) (Number of positive histories of prior ear diseases with present hearing unimpaired.)	12.37%	38,543
7. Total number of children recommended for 2A audiometer test on basis of 4A tests. (Total number of children with both ear impairments to be examined by school otologist.)		11,817
8. Total number of children tested with 2A audiometer and recommended for otological examination		7,528
9. Total number of children examined by otologists at school		2,068
10. Total number of lip-reading cases (February to June, 1934)		1,351
11. Total number of additional lip-reading cases since June, 1934		1,151
Total number of lip-reading cases		2,502
Total number of lip-reading teachers assigned		73
Total number of 4A technicians		61
Total number of 2A technicians		18
Total number of otologists		6
Total number of follow-up workers		13
Total number of research and clerical workers		9

vention of any deafness! Prevention of increasing deafness! Prevention of severe deafness! Prevention of total deafness! If anyone under the conditions can suggest a better way to approach our problems we will welcome him (or her) with open arms.

140 East 54th Street.

SINUSITIS IN CHILDREN.*†

DR. HERMAN J. BURMAN, New York.

The management of sinusitis in children is so largely a medical problem that known facts and currently accepted theories should be of interest to the general practitioner. Chronic nasal discharge from one or both sides of the nose is of course the symptom which brings the patient to the office. Frequent colds and earaches are also complained of.

History, and examination of the child will frequently disclose a constitutionally inferior individual. These children are often malnourished and underweight. They suffer from lack of appetite and constipation. The mother may say that the child is inattentive and not doing as well in school as she had hoped.[1]

Sinusitis, adenoiditis, and atopy are the most common causes for nasal discharge in children, and an exact diagnosis must be established before intelligent treatment can be undertaken. Infected adenoids, unless they are removed, will keep up a chronic discharge, usually bilateral, for an indefinite period in spite of the most heroic nasal treatment. Even though a child has had his tonsils and adenoids removed, pieces of adenoid tissue may have regenerated or may have been left at the original site by an unskillful operator. With the aid of a mouth gag the examining finger should be introduced behind the palate and if adenoid tissue is palpable it should be removed. In particularly recalcitrant children a whiff of ethyl chloride may be necessary to allow for proper examination. The improvement following such adenoidectomy is often truly remarkable. If there is no adenoid tissue to be removed or if adenoidectomy has been of no benefit, sinusitis or possible atopy must be considered.

PRACTICAL EMBRYOLOGY.

The sinuses are first evident in the third month of fetal life.[2] They begin as evaginations of the mucosa of the mid-

*Discussed before the Lincoln Hospital Alumni Association, April 16, 1934.

†From the Department of Otolaryngology of the New York Post-Graduate Medical School of Columbia University.

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dle and the superior meatus of the nose. The sphenoid sinus does not begin as an evagination, but rather as a constriction of the posterior, superior part of the nasal fossa. These evaginations of the mucosa extend into the bones after which they are named, the maxillary, the frontal, the sphenoid sinuses and ethmoid labyrinth. They gradually increase in size and occupy relatively large spaces in the bones. The starting points of the evaginations in the mucosa persist in the adult as the ostia for communication of the sinuses with the nasal fossae. These sinuses do not all grow uniformly and in the adult show great variation in the size and number.

The ethmoid labyrinth is the only sinus to be fully developed at birth[3] and is usually the only sinus to give trouble before the age of about 2 years.

The antrum is a small slit-like cavity which develops very slowly and has its ostium above the level of the floor of the nose.[4] Because in the creeping position the child's head favors drainage, the antra rarely gives trouble before the age of 2 years. It comes to this then, that as far as the sinuses are concerned, up to the age of about 2 years the ethmoid labyrinth is practically the only one that becomes diseased.

After the age of 2 years the maxillary and sphenoid sinuses may also be diseased, but the maxillary is by far the most commonly infected, the sphenoid more rarely causing trouble. The frontal sinuses, although present as buds, do not appear in the frontal bone above the nasofrontal line until the child is much older.[5]

DIAGNOSIS.

An exact diagnosis merely by inspection cannot always be made and one must resort to other aids, which will be described later. Before the nose can be properly inspected, it must be thoroughly cleansed of all secretions. We prefer suction by flexible metal or soft rubber cannulae. Irrigations may also be used, but we avoid it because of the danger of introducing aural infection. With the aid of the nasal speculum and good illumination, the nose is now inspected for evidence of disease. Congestion, edema and unusual hypertrophies of the turbinate bones are usually manifestations

secondary to sinus disease. A pale edematous mucosa is more likely to be associated with an atopic condition. When suspected, the patient should be completely tested to determine any sensitivity.

Discharge from the middle meatus is an indication that one of the anterior group of sinuses is diseased.[6] If the discharge is from above the middle turbinate, that is, from the superior meatus, then obviously the infection is in the posterior group of sinuses. Therefore, before the age of 2 years pus in the middle meatus is a fairly definite indication of ethmoiditis. Between the ages of 2 and 6 years, discharge in the middle meatus means involvement of either the ethmoids or the antrum. If the discharge is very profuse the antrum is probably involved, but differential diagnosis will be discussed later. After the age of 5 or 6 years, the frontal sinuses develop into the frontal bones and drain into the middle meatus.

Discharge seen coming from above the middle turbinate bone before the age of 3 years is always indicative of a posterior ethmoiditis because the sphenoid sinus is not fully developed and does not often cause trouble before this age.

Nasal discharge[7] is almost always present in chronic sinusitis and is most profuse on the side affected. It may be mucoid, mucopurulent, or purulent, depending on the severity of the infection. The secretion is usually thick, tenacious, and of a foul odor. The amount of secretion varies for the same reasons as those described below under headache. Nasal obstruction is alternating and intermittent and is usually more marked on the diseased side.

Headache is a foremost symptom, and has great diagnostic value in those children who are old enough to complain of it. Frontal headache most often indicates disease of the anterior group of cells. Occipital headache most often indicates disease of the posterior ethmoids and the sphenoid comprising the posterior group of cells. Intermittent headache is typical and depends on the drainage from the sinuses. Morning frontal headache diminishing in intensity towards afternoon usually indicates frontal or ethmoid involvement. The sinuses fill up at night while the patient is recumbent,[8] but in the waking upright position the dependent location of the ostia facilitates

drainage. Morning frontal headache increasing in intensity towards the afternoon usually indicates maxillary sinusitis, since this sinus drains better in the ventral recumbent position. In the waking upright position the ostium being above the level of the floor of the sinus, drainage is retarded. Morning occipital headache becoming intensified towards afternoon often indicates sphenoiditis because the ostium of the sphenoid is also above the level of the floor of the sinus.

Tenderness to pressure by the palpating fingers is a valuable diagnostic sign if it can be elicited. The thinnest areas of the sinus walls often are tender to pressure in disease of the sinuses. The thinnest part of the frontal sinus is in the supraorbital region near the supraorbital foramen; that of the ethmoid, the lamina papyracea, on the inner wall of the orbit; that of the maxillary antrum, over the canine fossa. In sphenoiditis the eyeballs are often tender to light pressure. To elicit tenderness over the sinus, place the index fingers against the corresponding areas of the sinus walls; for instance, the left finger against one canine fossa and the other index finger against the other canine fossa. Have the patient press forward against the palpating fingers to determine if one side is more tender than the other.

Having determined that the anterior group of cells are diseased one must try to ascertain which individual sinus or sinuses are involved. Transillumination and the Roentgenograph are of course preferable ways of dealing with children but the following procedure may also be employed whenever feasible. The maxillary antrum can be washed out through the natural opening or by puncture through the nasoantral wall. General anesthesia may be necessary but in a vast majority of cases this can be accomplished under local anesthesia. Pus or mucopus from the antrum is a positive diagnostic sign, although the other sinuses of the group may be involved. If the antrum irrigation is negative, the frontal or anterior ethmoids are at fault. The frontal sinus when present can be probed and if necessary washed out. If no discharge comes from the frontal after probing or irrigation then the diagnosis of ethmoiditis is made by elimination. In disease of the posterior group of cells the nasopharyngoscope and the postnasal speculum may aid in determining whether the posterior ethmoid or the sphenoids are at fault.

Transillumination should be done as a routine measure for confirmatory evidence. The patient should be placed in an absolutely dark room and each frontal region transilluminated in turn by placing the tip of the porcelain tube under the supraorbital wall. The two sides are compared and a positive diminution in illumination is diagnostic. Negative findings should be ignored. The maxillary sinuses are transilluminated by placing light against the malar region just below the rim of the orbit and the palate is inspected through the open mouth to see if there is any variation in illumination on either side. The light is then placed in the mouth and if the child is old enough it is then instructed to close the lips but not the teeth. Normally the antrum should be light about the nasolabial angle, show a shadow over the malar region and be light again under the eye. If pathological changes have taken place and the lining of the antrum is thickened, the diseased side is darker and the pupillary reflex is lost. The ethmoids cannot be satisfactorily transilluminated. The sphenoids cannot be transilluminated. This diagnostic procedure is of more value when the sinus disease is unilateral since the normal side is then a basis for comparison.

Roentgenography is a valuable aid in making an accurate diagnosis of sinus disease. It accurately delimits the anatomy and often makes a differentiation between free fluid in the sinus and a thickened lining membrane. A comparision between normal and diseased sinuses can be made and foreign bodies or new growths may be demonstrated by it. Septa in the sinuses will show up on the X-ray and are important if surgical intervention should be requisite. Radio-opaque solutions[9] injected into a sinus have been helpful, and stereoscopic films are of more aid than flat ones.

Chronic sinusitis frequently presents a difficult matter for diagnosis especially in the nonsuppurative type. The history is very important and if the patient tells of repeated occurrences of colds in the nose or suppurative sinusitis or acute lymphadenitis, the sinuses should be suspected. In general it may be said that hypertrophic, or hyperplastic middle or inferior turbinates, polypi, or polypoid degeneration anywhere in the nose or exudate in the middle or superior meatus should make one suspicious of the sinuses. Enlargement of the posterior cervical glands is almost always present in sinus diseases and

is of particular value in the diagnosis of chronic latent infection. In chronic infection there is only a moderate increase in the leukocyte count usually to from 9,000 to 12,000. There is also slight red blood cell destruction. In the latent types of infection there may be only a small rise in the leukocyte count but there is usually a relative increase in the lymphocytes of from 40 per cent to as high as 80 per cent. The eosinophiles and basophiles are also increased in number.

SINUS DISEASE AS A FOCUS OF INFECTION.

The organisms commonly affecting the nasal accessory sinuses are the streptococcus, staphylococcus, pneumococcus, Friedlander's bacillus and B. influenza. Absorption of these bacteria into the blood and lymph vessels of the mucosa lining the sinuses takes place and so infection in remote parts of the body may occur.[10] The hematogenous infection is the more common. Secondary infection from the sinuses may occur anywhere in the body but the more common sites are the joints and tendons. The endocardium, myocardium, pericardium, the bronchi, and kidney are frequently affected. The nonspecific cases of arthritides are thought to be due to an allergy produced[11] by the protein of the micro-organisms. Acute or chronic conditions may act as foci of infection and latent foci may exist without demonstrable local, or systemic manifestations. Direct infection of the lower respiratory and gastro-intestinal tract may also occur when infective material drops down from the postnasal spaces in the trachea or esophagus.

Bacteriological examination may be of assistance. The isolation of organisms with similar culture reaction from any focalized infection and the secondarily infected tissues is of course good evidence of the relationship of these two. Chronic inflammation may be due to continued or recurrent metastasis from the original focus and the remote effects not easily recognized. Disturbance of function is the only manifestation of these insidious continuous chronic infections which are of such low virulence that they do not produce tissue changes.

HOME TREATMENT.

Because acute exacerbations of a chronic sinusitis do occur it may be well to describe the treatment here. Rest in bed

is most important since this builds up the resistance and gives the body a chance to overcome the infection. A mild cathartic rather than a purge is very helpful at the onset of the disease. Castor oil, milk of magnesia, in a one-half tablespoon dose or any of the coated phenolpthalein products in a 1 gr. dose are given.

To induce perspiration and abort the course of the acute attack, pulvis ipecacuanhae et opii gr. V (for a child of 5 years) is adminstered at night. This should be followed by a tub bath or a hot foot bath and the patient should be well protected in going from the bath to the bed. When in bed hot fluids, preferable prepared with lemon or orange, and in large quantities increase perspiration and aid elimination. The following day atropine sulphate (1:1000 solution) in two-drop doses is given by mouth every two hours and is persisted in until the discharge from the nose is greatly diminished, the mouth feels dry, or the patient shows a flushed face or dilated pupils.

Salicylate salts of sodium or potassium or acetyl salicylic acid in 5 gr. doses are given three times a day to control the constitutional symptoms.

Ephedrine 0.5 per cent in liquid petrolatum is beneficial wherever the sense of obstruction is very distressing. This may be sprayed in with an atomizer, directing the nozzle of the spray first up towards the eye and then backwards towards the ear. If the medicine is to be inserted with an eye dropper then the patient should be recumbent with the head extended off the edge of the bed and the chin pointing to the ceiling. Two or three drops in each nostril three times a day is generally sufficient. The bland ointment of zinc or boric acid may be applied to the nares and upper lips whenever there is much excoriation.

For severe pain in the face or head any analgesic preparation may be used. A combination of amidopyrinae, acetphenetidini and codeine is generally efficient. Steam inhalations are often very soothing and may be prepared by pouring a teaspoonful of tincture of benzoin or a tablespoon of milk of magnesia on the surface of some boiling water and the steam inhaled through the nose. Heat rays from an ordinary baking lamp often gives more comfort and it helps to allay pain.

OFFICE TREATMENT.

Office treatments may be begun when the patient's temperature has been normal for at least 24 hours, when there is still discharge from the nose, if nasal obstruction still persists, or if complications have set in.

Spray into the nose about 0.5 per cent cocaine solution to which some epinephrine in (1:1000 sol.) has been added in the proportion of 10 drops to the drachm of cocaine solution. This is sufficiently strong to produce shrinkage of the nasal mucosa and weak enough to avoid the toxic effects of cocaine. Wait a few minutes and then insert a flexible metal cannula or a rubber catheter which is attached to a suction pump to cleanse out all the secretions on the floor of the nose and from the area under the middle turbinate, the latter being the place of drainage from the ostia of the sinuses most often affected. Irrigation of the nose with warm bicarbonate of soda solution may be used to cleanse the nose but there is a danger of producing middle ear infection and it is not recommended.

Negative pressure is sometimes employed and may be produced by the Sonderman suction bulb which consists of a glass nasal tip attached to a rubber bulb. This rubber bulb is compressed, and the nasal tip is placed into one nostril. The other side is closed up while the patient says K K K and the bulb is allowed to expand so producing suction in one side of the nose. In small children this is of course not practicable. The same thing applies to the Coffin sinus cleanser which is used in conjunction with a suction pump.

After the nose has been thoroughly cleansed, oily sprays such as menthol 0.5 per cent in liquid petrolatum or menthol and camphor oil each 1 per cent in liquid petrolatum should be sprayed into the nose. This leaves a protective layer of oil on the mucosa, diminishes the chance of fresh infection and gives a sense of coolness and clearness in the nose. This conservative office treatment, together with the general supportive treatment discussed later, must be persisted in for a long period of time in order to obtain results, unless complications have set in or there is no definite sign of improvement.

CONSERVATIVE SURGICAL MEASURES.

In antral infections where conservative measures as outlined, and general hygienic treatment are of no avail, it may

be necessary to irrigate the maxillary sinus either through the natural opening or by puncture through the nasoantral wall. This may require a general anesthetic but can very frequently be done under local anesthesia. In children who have had many irrigations and the discharge persists, an intranasal antrotomy is advisable to leave a large opening which can be irrigated by any metal cannula. Radical surgery of the antrum is rarely indicated.

When the frontal sinuses are involved, cocainizing the middle meatus with 10 per cent cocaine epinephrine may prove sufficient to facilitate drainage and in conjunction with negative pressure often prove sufficient to cure the disease. Catheterization of the frontal sinus and even irrigation may be attempted but most often it is difficult because the anterior tip of the middle turbinate is in the way.

Ethmoiditis is of course the most common difficulty, and should be treated as outlined by shrinking the middle meatus and using suction. Occasionally a purulent ethmoiditis will point externally and will have to be incised. All that is necessary is to make a small incision through the skin down to the bone over the fluctuating area and allow drainage. Intranasal surgery on the ethmoids should never be done in children.

In sphenoiditis the shrinking solution is placed between the septum and the middle turbinate so as to allow drainage from the superior meatus. Negative pressure is of value. Occasionally the sphenoid may have to be probed and irrigated.

Partial submucous resection is sometimes necessary even in children to permit proper drainage of the sinus areas.

GENERAL SUPPORTIVE MEASURES.

The general hygienic treatment aims at building up the general body resistance, and diet should first be considered. The blood is slightly alkaline in reaction. In every case of sinusitis, whether acute or chronic, the alkalinity of the blood and urine is diminished. This relatively low alkalinity is manifested by an acid urine, the acidity of the urine being greatest in the more acute cases of sinusitis.

Excess inorganic acid which is not neutralized by inorganic bases, attack the protein of the body, forming injurious am-

moniacal compounds. It also interferes with the proper calcium metabolism which is necessary for the reparative processes of the body. A diet rich in alkaline nutrition is therefore recommended by some clinicians as of value in sinusitis.

Salt restriction is important when the mucosa is congested since it counteracts the tendency towards exudation. One gram of salt retains 70 gm. of water in the body in order to remain in solution.[12]

The proper climate is one which is moderately warm, dry, free from dust and free from smoke and from sudden variation in temperature. Such climate is usually found in the southwest of the United States, often in the southern part of Florida and on the Gulf coast. It is generally found that patients, although they are relieved of their symptoms by a prolonged stay in warm, dry climate, promptly have a recurrence of symptoms upon return to the northern and temperate zones.

Diving and swimming, which allows water to get into the nose, are forbidden.

Light therapy, both ultraviolet and infrared, are of some value in sinusitis. Among other physiological effects the red rays stimulate phagocytosis. They attenuate heat sensitive micro-organisms and they produce a dilatation of the blood vessels with the production of an active hyperemia, which may have a beneficial effect. Ultraviolet light produces a tissue hyperemia as one of its visible manifestations and it also has a bactericidal and bacteriostatic action, although response to ultraviolet appears to be different in various bacterial species. The red blood cells are increased in number but the hemoglobin content is not altered. The lymphocytes, the blood platelets and the alkalinity of the blood is increased, as is the calcium and phosphorus absorption. The coagulation time of the blood is decreased after exposure to ultraviolet.

Nitrohydrochloric acid has been given by mouth on the theory that by increasing the acidity of the stomach content, it is retained longer when it gets into the duodenum and so increases the calcium metabolism which is of value in the reparative processes of the body.

Calcium in the form of the lactate or gluconate may be given together with parathyroid extract, which is believed to activate the calcium.

Vitamin therapy, especially with viosterol, is now the vogue and may be very beneficial especially in malnourished children.

In children with a low metabolism thyroid extract in small doses is of definite value.

Autogenous or stock vaccines, preferably the former, have produced definite improvement in some cases and have markedly diminished the tendency to reinfection of the sinuses.

CONCLUSIONS.

Sinusitis in children can be treated in a logical and scientific manner.

Knowledge of the development of the sinuses helps to simplify the diagnostic problem.

Adenoiditis and atopy if present must be eliminated before treatment of the sinuses is undertaken.

Ventilation and drainage are the primary surgical principles.

Intranasal surgery should never be attempted in children.

General hygienic and medical supportive treatment is as important as the local nasal measures.

Persistence in treatment is necessary to obtain good results.

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1235 Grand Concourse.

SOME FEATURES IN SINUS OPERATIONS AND THERAPY.

DR. JOSEPH PRENN, Boston.

We are concerned here mainly with the acute and subacute sinusitis of the antrum and sphenoid, and the hyperplastic type of their respective mucosa. When there is an existing empyema of the sinuses, the preoperative diagnosis is usually made by the clinical (subjective and objective) signs, transillumination of the antrum and X-ray of the antrum and sphenoid respectively. Of the objective signs the appearance of pus over the body of the inferior turbinate is presumptive evidence of pus in the antrum. The pharyngoscope helps, at times, in diagnosing infections of the sphenoid.

When, however, there is very little pus in the sinuses, about 1 cc. or less, there may be only vague spasmodic subjective signs, such as intermittent pain of the face on the affected side, dull headache and lack of concentration, especially in the morning hours when there was not sufficient time for natural drainage. The patient may come to the office to find that he cannot concentrate on his work with a dull feeling in his head. Objective signs may be absent or not detected. Transillumination as well as X-ray may give negative interpretations as to pus. One cc. or less of pus, spread over a large area, may not show any perceptible shadow. Yet such a sinus may serve as a focal infection and by absorption bring about symptoms and infections in other remote parts of the body.

When the infection of the sinuses is of long standing or when they have been subjected to many recurrent attacks, we get a change in the mucosa. It becomes hyperplastic and the X-ray may show a thickened mucosa. In the latter type, as the name implies, we have an augmentation of hyperactive cells. The secretion is more viscid, sticks to the mucosa for a longer time, the same as we find in chronic nasopharyngitis. It evaporates less easily, if at all. By its presence and pressure on the mucous epithelium, it causes the latter to degen-

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erate with the formation of polypi at times. The latter is more readily diagnosed by X-ray, after the sinus has been filled with an opaque solution showing a filling in defect.

Suction will almost invariably decide whether there is any pus present, however small the amount. The writer has obtained pus in the syringe as little as 0.5 cc. when all other diagnostic methods were negative except for vague subjective signs. Suction also elicited thick, stringy mucopus in other cases, while X-ray and transillumination were negative.

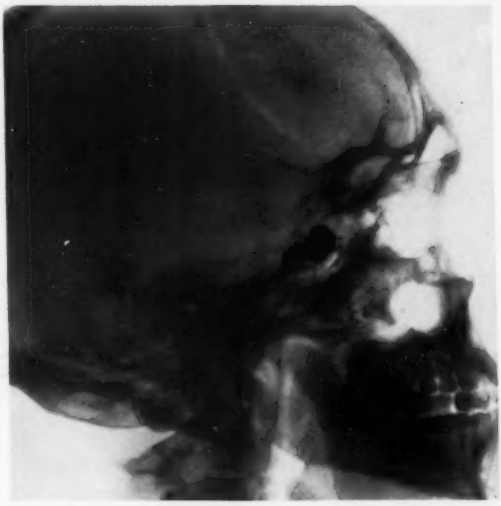

Fig. 1. The sphenoidal sinuses have been injected with lipiodol. Polyp has been removed from the nasopharynx.

Stringy mucopus when adherent to the wall of a sinus may not show up in the X-ray. Ordinary washings previously done also elicited negative results. Suction is really the antithesis of squeezing out the walls of a pus cavity.

The procedure the writer practices and finds very satisfactory is as follows: In acute and subacute cases we draw all the pus out until serum appears in the syringe and air is heard to enter the sinus (in case of antrum infection). When the pus is too thick to go through the trocar, an alkaline solu-

tion is injected into the sinus, allowing it to remain a little while. The pus will then readily go through into the syringe. It is facilitated still more by previous inhalations of ethyl-iodide. The latter enters the sinus together with the air during the act of respiration and liquefies the tenacious mucus. When we are reasonably certain that all the pus has been removed at the time, we inject Dakin's solution. Let it stay for a while and withdraw it back into the syringe. In mild cases this is usually sufficient, as pus is absent, on suction,

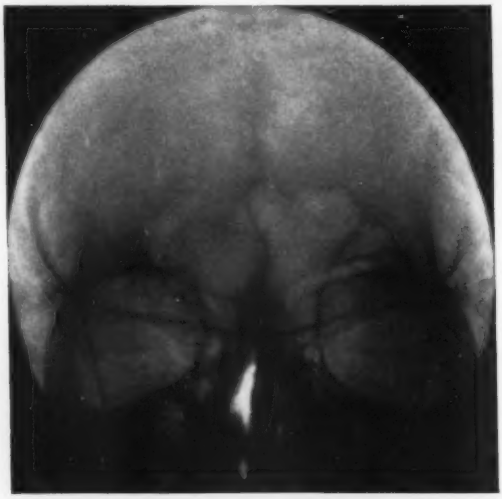

Fig. 2. Patient had bilateral suppurative ethmoiditis with thickened antral mucosa. A large infected ethmoidal cell shown in the right frontal. The ethmoidal cells on both sides have been curetted. (Modified Mosher operation.) Twenty-five per cent argyrol injected in the right ethmoido-frontal cell and the antra filled up with the argyrol solution.

at the second visit. In severer infections, this procedure has to be repeated on the second visit. The mucous membrane is not healed yet and pus may still be formed by the pyogenic bacteria contained within the mucosa. So far the writer did not find any pus on the third visit. The sinus is left dry by this method. There is less likelihood of spreading infection, as no fluid pus is allowed to go into the naso and oropharynx. The contents of the sinuses go into the syringe. The patient is also more comfortable this way. When we inject Dakin's

solution we instruct the patient to raise his hand as soon as he smells or tastes the solution. We know then that the sinus is full. The same instructions are given when we inject lipiodol or argyrol for diagnostic and in the latter also for therapeutic purposes.

In the hyperplastic type of the antrum and sphenoid we have a different problem to solve. Not only do we have to clear the sinus of mucus and mucopus, but we have also to

Fig. 3. Showing opacity of the antra containing 25 per cent argyrol. Fluid and pus have been removed previous to injection.

apply to the entire mucous membrane of the sinus some antiseptic and astringent; some means of restoring it and its function to as near normal as possible.

Mechanical cleansing and antiseptics applied to and around the ostea, such as postnasal and nasal applications, help; but it is obviously insufficient. Squirting in some solution, even by the guidance of the pharyngoscope, does not fill up the cavity. By inserting the cannula into the sphenoid or antrum and

injecting the solution with a syringe as above, we know that the solution is in and the sinus is filled up with it.

We use a 25 per cent solution of argyrol for that purpose and leave part of it in. The injection is made after suction has revealed, first, a dry sinus. The procedure is very simple. It is usually done under local anesthesia with very little discomfort to the patient, especially if he has had preoperative preparations in the line of sedatives to allay nervous irritability and apprehension. The solution is subsequently drained out by itself, aided by natural suction. While in the sinus, the argyrol is being automatically applied to the entire mucosa, due to the different positions the head assumes during waking or sleeping hours. Ethyliodide helps to tone up the mucosa as a follow-up treatment.

Fig. 4. For suction and injection of the sphenoidal sinus. The cannula ends in a bulbous tip. The same arrangement is used for the curved antrum trocar.

We can utilize the opaque solution of argyrol for Roentgenoscopic purposes to show the filling in defect caused by polypi, etc. It is advisable to place the patient in a prone position immediately after the injection is made. While it does not show as dark an opacity as lipiodol, yet it throws a sufficient shadow for interpretation. Argyrol has the added advantage of an efficient therapeutic agent.

I take the opportunity here to express my gratitude to the Department of Anatomy, Tufts Medical School, where I was able to clarify, on wet specimens, the approach to the sinus operations; to Dr. H. P. Mosher for the courtesy in allowing me to again examine his preparations in his laboratory at the Harvard Medical School; to the X-ray Department and Ear, Nose and Throat Staff of the Providence Hospital, Holyoke, Mass., for the courtesy in forwarding to me the X-ray for print.

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14 Charlesgate West.

The Thirteenth Annual Summer Graduate Course in Ophthalmology and Oto-Laryngology will be given in Denver, Colo., July 15 to July 27, 1935, under the auspices of the Colorado Ophthalmological Society — Colorado Oto-Laryngological Society.

THE NEED FOR IMPROVED TECHNIQUE IN TONSILLECTOMY.*

DR. ARTHUR F. HOLDING, Albany, N. Y.

Because tonsillectomy is more frequently performed[1] than any other operation, everyone has a more or less intimate knowledge of it; because it is such a simple operation it is undertaken, perhaps, too lightly. The complications are often serious, and these become a subject of gossip among the laity, while the uncomplicated cases are taken for granted by the profession.

The present conservative view of tonsillectomy is indicated by the critical attitude of some of our prominent pediatricians, by the astonishing lay popularity of a medical analysis of the end results in tonsillectomy such as Kaiser's "Children's Tonsils In and Out," and by the wide interest shown periodically in supposed substitutes for the operative removal of tonsils (such as radium, X-rays, electrocoagulation, etc.).

The frequent occurrence of hemorrhages; the often prolonged convalescence; the so-called recurrence of tonsils; the disappointing results of the operation when performed in the hope of preventing "common colds,"[2] are all matters of general knowledge. These, together with the occasional post-tonsillectomy lung abscess,[3] emphasize the need of improvement in this special field.

INDICATIONS AND CONTRAINDICATIONS.

The first condition to be observed in the development of an improved technique is to operate only where operation is clearly indicated. These indications have been stated by such observers as Kaiser[4] and Fowler[5] and are, briefly, as follows: Interference with breathing or swallowing, due to faucial or postnasal obstruction, commonly shown by mouth-breathing; adenoid facies; snoring (in children); nasal voice; bad breath (due to debris in tonsils); persistent nasal dis-

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charge, unrelieved by simpler methods; otitis media in children; recurrent attacks of tonsillitis or quinsy; enuresis; anorexia; sinusitis accompanied by postnasal discharge and persistent headaches; enlarged cervical glands; rheumatic fever; also in some cases of focal infection manifested by symptoms of pyelitis, nephritis, cyclic vomiting, etc., and in diphtheria carriers.

As regards disappointing results in cases where tonsillectomy was performed for the relief of persistent colds, it should be recognized that the commonest (indirect) cause of the common cold is not hypertrophied tonsils, but sudden changes from heat to cold. These sudden changes are indigenous to our climate and are aggravated by systems of artificial heating without air conditioning, by "cold air" fads, and by fashions of inadequate underwear, bare legs, etc.

It is noteworthy that in diphtheria carriers and in patients complaining of sore throats, head colds, repeated attacks of unexplained fever, laryngitis, otitis media and cervical adenitis, the improvement of these symptoms was not as uniform when tonsillar fragments were left at operation as it was in similar cases where the removal of tonsils and adenoids was complete.

The fact that tonsils are large is not, in itself, a sufficient reason for their removal.

Tonsillectomy is contraindicated in the following conditions: Hemophilia; blood diseases, such as Hodgkins' disease, leukemia, severe anemia; thymic diseases; acute infection, local or cardiac. When removal has been decided upon, only improved methods should be used.

ANESTHESIA.

For children and apprehensive adults tribromethanol is our first choice as a primary anesthetic; this can be followed, if necessary, by ether. As an alternative we use the ethyl chloride-ether sequence. Shock is diminished, greatly to the advantage of patient and relatives, if the patient goes to sleep in his room, waking several hours after the operation is completed without remembrance of going to the operating room or of taking a general anesthetic. For adults who object

to general anesthesia, we use quinine and ureahydrochloride by a single deep injection, as advocated by Trotter.[6]

In order to make the field as nearly dry and bloodless as possible, we follow Webb's method of having the patient breathe through the mouth for half an hour before the operation by having him hold a wooden tongue depressor edgeways between his teeth; we also blanch the mucous membrane along the line of incision by means of novocain and adrenalin solution injections.

METHODS.

A knowledge of the evolution of the methods of tonsillectomy is necessary to the understanding of their respective merits. Until comparatively recent years nose and throat specialists have favored special instruments for this operation, the first of which is said to have been devised by a Norwegian peasant in 1641.[7] The first real tonsil "guillotine" was produced in 1828. Fifty years later Mackenzie[8] improved his guillotine and Mathieu brought out an instrument that he called a "tonsillotome." In the operation of *tonsillotomy* it was generally considered necessary to leave a part of the tonsil in place in order to avoid postoperative dryness of the throat.

During the years in which these guillotines were popular, *tonsillectomy* was practically unknown. Sluder[9] produced the first so-called automatic instrument with which a tonsillectomy could be performed, by modifying the Mackenzie guillotine, making the blades dull and the whole instrument heavier. As first used his method was somewhat brutal and, when the operator was unskilled, wide destruction of the pillars of the pharynx often resulted; also, it was extremely apt to leave a small remnant of tonsil. The popular expression of taking the tonsils "out by the roots" probably originated in the Sluder method or the finger dissection of Foster.[13] In order to overcome the necessity for great strength in the operator using the original Sluder tonsillectome, various modifications were devised, such as those of Ballenger,[10] Demarest, La Force and others.

The Sluder method can be used only when there has been little or no peritonsillar inflammation. We use this operation

in 90 per cent of our patients who suffer from hypertrophied tonsils. When well done, it possesses the following advantages over tonsillectomy by dissection: it is quicker and easier to perform when once the knack is acquired, and there is less postoperative hemorrhage and discomfort. Its disadvantage, as compared to the dissection method, is that the tonsil alone is removed and sometimes not completely, since it is very easy to crush through a part of the tonsil instead of behind it, leaving a small remnant which later may cause trouble. The Sluder instrument does not remove the subtonsillar lymph follicles situated between the inferior pole of the tonsil and the base of the tongue. These should be removed by dissection or they will hypertrophy, giving the impression that a piece of tonsil was overlooked.

Utilizing the fact that the tonsil was intimately attached to the anterior pillar and very loosely to the posterior, Beck[11] invented a *tonsillectome* (also known as the Beck-Schenck tonsillectome) with a wire snare hidden within a ring. After the tonsil was pushed through the ring, this snare was gradually drawn tight, from behind forward, by the use of a thread and screw arrangement, producing a slow crushing at the base. Braun[12] made a still more complicated tonsillectome on the same principle.

Tonsillectomy by finger dissection, at one time so popular in certain medical circles and now almost abandoned, was devised and perfected by Foster.[13] The scissors dissection method makes use of essentially the same technique with instruments.

As we use it, the Beck-Sluder operation consists in thrusting the ring of the tonsillectome into a sterile rubber finger cot and everting the tonsil through the ring of the Sluder instrument; next shelling out the tonsil from its capsule from behind forward by tightening a snare hidden in the ring of the instrument, thus gradually separating the tonsil from its attachment to its bed and to the anterior pillar of the pharynx. The tonsil is delivered in the finger cot, together with all secretion (no tenaculum is used). Finally the tonsillectomy is completed by withdrawing the instrument and the tonsil. The operation may be made bloodless by taking sufficient time in tightening the snare or by applying a cautery current to

it. It is almost impossible to injure the pillars of the pharynx or the uvula with the snare-ring modification of the Sluder instrument. A cuff of mucous membrane is left covering the edges of the pillars, decreasing to a minimum the pain caused by swallowing. Placing a sterile finger cot over the fenestrum of the tonsillectome secures the delivery of the tonsil and all pathological secretions in a sterile bag and also obviates the use of a tenaculum.*

This operation can usually be done, without hurrying, in less than fifteen minutes and, with two anesthetists, eight cases per hour is the average number. Speed, however, is of minor importance. This method is very dangerous to the reputation of the operator unless infinite care is taken in the inspection of the capsule and of the tonsillar fossa after removal, in order to discover whether any fragments remain. A small piece of tonsil may easily slip out of the fenestrum and be left to cause persistent sore throats after tonsillectomy.

With the advent of nose and throat specialists who were also trained in general surgery, the dissection method of tonsillectomy was perfected. The blunt dissection of former years has been succeeded by the sharp dissection. Among the many teachers contributing to the success of this method should be mentioned Coakley,[14] Barnes,[15] Painter,[16] Fisher,[17] Crowe[18] and Fowler. Crowe, at Johns Hopkins, has devised an exact technique. In this method great care must be exercised to remove "the tonsil, the whole tonsil, and nothing but the tonsil" (Fowler), and to spare the tonsillopharyngeal muscle. No such care is necessary in the Sluder method for the throat muscles are automatically protected from mutilation. The saving of the tonsillopharyngeal muscles in the Sluder operation is the rule, whereas in the dissection method it is the exception.

POSITION.

Among the many positions that have been tried are the following: the upright; the dorsal; the Rose (dorsal position with the head extended over the end of the table); the Trendelenberg. The dorsal is the most frequently employed, but

*Dr. George E. Wilson, of Saranac Lake, N. Y., demonstrated this "in the bag" method to the author.

experience, checked by careful records of blood pressure, postoperative bronchoscopic examinations and incidence of postoperative complications has shown that the Rose position is the position of choice. The Trendelenberg is the second choice, and the upright position the most dangerous.

As far as I can discover, the originator of the Rose position left no description of this valuable contribution to the surgery of the mouth and throat. The only description that could be found in the medical library of the New York State Department of Education and the library of the New York Academy of Medicine was a reference in Rose's obituary.[20]

Crowe[18] has described the merits of the Rose position. With it the field of operation is always clearly in view and is unobscured by hemorrhage. This position has made it unnecessary ever to ligate the carotid artery for control of hemorrhage.

ADENOIDS.

Incomplete removal of adenoids is responsible for quite as many disappointments in tonsillectomy as incomplete removal of the tonsils themselves. While the removal of the former is not more difficult than that of the latter, it often receives less attention than it deserves. When requested by pediatricians or fortified by the approval of a consultant we do adenoidectomy without tonsillectomy in young children when such a procedure is clearly indicated.

ELECTROCOAGULATION.

Careful dissection and microscopical examination of the fascia surrounding the tonsil has shown that some acini of the faucial mucous membrane do penetrate the so-called capsule of the tonsil; therefore it is to be expected that these may present postoperatively superficial inflamed foci of tonsillar mucous membrane remnants. This may be avoided by wide dissections, but these may damage the intricate meshwork of the pharyngeal muscles, as shown by Todd.[21] The cautery plays an important role in the removal of any small localized remnants, as well as in hemophilia and in the treatment of adults who refuse tonsillectomy. The actual cautery

will be found useful for coagulating small areas, and high frequency currents for coagulating larger areas.

CONCLUSIONS.

1. Improved tonsillectomy technique insures: less excitement and shock to the patient and relatives; less postoperative discomfort; quicker convalescence with fewer complications; shorter period of hospitalization; lower mortality, safer operations, and less expense.

2. The term, *improved tonsillectomy technique,* as we use it, means: *a.* operation only when clearly indicated; *b.* use of tribromethanol as a preliminary anesthetic in children or apprehensive adults; *c.* use of improved Sluder methods when possible; *d.* use of the Rose position when possible; *e.* careful control of hemorrhage at time of operation; *f.* complete removal of adenoids; *g.* thorough postoperative inspection of the field of operation; *h.* postoperative follow up; *i.* removal of any remaining tonsil tissue by cautery.

3. General surgeons and general practitioners will continue to perform tonsillectomies until the majority of nose and throat specialists justify their specialty by performing better operations.

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142 Washington Avenue.

SYPHILIS OF THE TONSIL. REPORT OF TWO CASES.

DR. FRANCIS S. MAINZER, Clearfield, Pa.

There seems to be a wide variation of opinion among authors as to the frequency of syphilis of the tonsil. Some authorities believe it is the most frequent of all extragenital primary lesions. It is true that an extragenital chancre is harder to diagnose because it is not usually thought of as a chancre of venereal infection, but any suspicious lesion of several weeks' duration, especially with enlarged nearby lymphatic glands that are hard, ought to be considered with the utmost care and suspicion. The mode of infection is a problem but it is thought that kissing is the most important factor while the careless use of a drinking glass and eating utensils are next. Again pipes, cigars, cigarettes, mouthpiece of wind instruments, nursing bottle nipples, etc., that have been in the mouth of a syphilitic have been reported. Abnormal sexual practices no doubt must be considered, but can one obtain such a history?

Chancre of the tonsil is as a rule unilateral but rarely occurs on both sides. Sore throat is usually the first symptom noted by the patient which is followed by swelling of tonsil and soreness, next, enlargement of lymphatic glands, draining this area.

The tonsil is enlarged, very red in color, ulcer is present which varies in size, is covered with a dirty greenish-gray exudate. The base of ulcer is hard and indurated with eroded border. One must differentiate syphilis of the tonsil from acute tonsillitis, Vincent's angina, diphtheria, peritonsillar abscess, malignant disease of tonsil, tuberculous ulcer.

It is true that when the secondary skin lesions appear the diagnosis becomes definite. This being the fact in both of our cases, made the diagnosis clear at once.

Case 1: J. K., age 23 years, admitted to the Clinic complaining of sore throat, difficult swallowing, cough and expectoration of one week's duration. Examination revealed a large red tonsil on the right side in the center of which was an ulceration

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covered with a dirty greenish-gray exudate. The submaxillary and cervical glands were enlarged and hard. An examination of penis showed it to be free from scar, but on the body were found numerous typical copper colored spots. The history obtained was that he had been kissing a woman, who, it was found by careful questioning, was attending this same Clinic and being treated for syphilis.

Wassermann was 4+ so that he was immediately given 0.9 gm. neosalvarsan intravenously. After the first injection the ulceration of tonsil disappeared while after the third treatment the skin lesions were absent.

Case 2: R. S., age 38 years, referred by his physician complaining of sore throat of five days' duration, with general macular skin eruption.

Examination revealed a large, very red tonsil on left side, the center of which contained a large ulcerated surface covered with a dirty gray exudate. The lymph glands of left side of neck were enlarged.

The history of this case was very vague as nothing definite could be obtained. Wassermann was 4+. Intravenous injection of 0.9 gm. neosalvarsan was given and in three days the ulcer disappeared. This was followed by intramuscular injections of bismuth in conjunction with the neosalvarsan intravenous and following the sixth injection the macular skin lesions had disappeared.

A CRITICAL ANALYSIS OF METHODS OF PHYSICAL THERAPY IN RHINOLARYNGOLOGY.*

DR. LEE M. HURD, New York.

At the present time, electrotherapy has superseded a number of the older methods, and the rhinolaryngologist should investigate and determine in what way this form of treatment may become an essential and valuable adjunct to his armamentarium.

Radiant light heat causes active hyperemia which relieves stasis, thereby relieving pain. It can be applied locally to relieve stasis in all acute inflammations of the respiratory tract from the nose to the bronchi. The method is simple, the beam of light is directed on the part affected, and at such a distance that the heat can be continuously tolerated. It is used until the general body heat becomes uncomfortable, then discontinued until the heat would again feel pleasant. Every family should own a radiant lamp.

Ultraviolet, of two lamps, one I have given away, and the other accumulates dust.

Diathermy is heat produced by the resistance of the tissues to the passage of an oscillating current. This can be controlled from mild warmth to tissue destruction. Every rhinolaryngologist should have a high frequency apparatus which will produce a satisfactory cutting and also a coagulating current, because there are so many conditions where diathermy gives better results than older methods.

In the past where the snare with cold wire was used, the same snare with the cannula insulated and No. 3 instead of No. 5 wire, electrified, can be used with the result that there is a bloodless field and no packing is required.

Nasal synechiae may be destroyed with the coagulating current and the coagulum left in place while the two bases heal.

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Epistaxis, if the bleeding point can be seen and touched with a ball tipped electrode, the vessel will be closed.

Granulation tissue forming after nasal operations may be readily destroyed, bloodlessly, with a light coagulating current.

Abscesses may be opened with the cutting current, bloodlessly, and without spread of infection. This is also true of hematomas of the septum.

Cysts: Diathermy is by far the best way of dealing with cysts. The procedure is to incise a button out of the wall with the knife current, drain the cyst and then destroy all the lining membrane with a ball tipped terminal and coagulating current.

Hypertrophy of the Inferior Turbinates: A far better method than surgery or the galvanocautery is to use the biterminal needles which destroy a ribbon of tissue submucously, reducing the turbinate without destroying the mucosa.[1]

Lymphoid Tissue: We at last have a means of eradicating lymphoid tissue in the Fossa of Rosenmuller and about the Eustachian tubes, which causes so much trouble in the tympanum. It is delicate work and should not be attempted by a novice.[2]

Granular and lateral pharyngitis respond to coagulation.

By far the best method of destroying postoperative tonsillar remnants is by electrocoagulation.

This brings up the perennial argument about removing the tonsil by electrocoagulation. The only rational argument I have heard is that if electrocoagulation is the best way to remove the remnants, why is it not the best way to remove the whole tonsil? Also, if surgery is so successful, why are there any remnants?

I have gone over the question several times before and will only say here that it is slow for the doctor and tedious for the patient, and it is not free from danger of complications. It has its place but it is not the operation of choice.[3]

After local tonsillectomies the bleeding points may be picked up with insulated nasal forceps, and coagulated. It is much

quicker than tying the vessels, and so far I have had no bleeding afterwards.

For hypertrophied lingual tonsils and veins, coagulation is as satisfactory as the guillotine and galvanocautery.

In leukoplakia it is a very good way to destroy the patches.

Malignant Growths: For their destruction and removal, where such is indicated, diathermy is the best method.

For pain in acute frontal and antral inflammations, a properly applied terminal producing heat to tolerance, nearly always relieves the pain.

Ionic medication, a fairly old procedure, has been recently brought to our attention as a method of relieving hay fever and other allergic conditions of the nose. Although it certainly arrests the hay fever symptoms and relieves some of the vasomotor conditions, it has not been in use long enough to determine its actual value and dangers. We can only arrive at that after a longer period of time, and a greater number of cases have been studied.

X-ray has a place in the office. Children with lymphoid follicles in their throats will improve considerably under small repeated doses of X-ray. The same is true for some chronic congested tracheas for which no cause can be found. Tuberculous glands of the neck, if not broken down will usually subside under repeated small doses, if the tonsils have been removed. Certain types of malignant growths in the nose and throat, of the radiosensitive group, respond more readily to radiation, X-ray or radium than they do to surgery. But the treatment of these radiosensitive growths of the upper air passages belongs to the radiologist and not the rhinolaryngologist.

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SCIENTIFIC STATUS OF PHYSICAL THERAPY IN OTOLOGY.*†

DR. A. R. HOLLENDER, Chicago.

The literature of the past 50 years contains numerous references to the therapeutic employment of light, heat and electricity in a number of aural diseases. It is, however, only within very recent years that a systematic effort to free this sort of therapy from empiricism has been followed by a measure of success. At least one may today speak of a scientific status of physical therapy in otology. For this reason a critical evaluation of its rationale is timely.

Time was when even experimental application of physical procedures was looked at askance, but today in certain quarters the tendency points to the other extreme. Neither an uncritical nihilism nor an unsupported optimism have a place in modern science. Indeed progress in any scientific endeavor is attainable only through unprejudiced research with the aim of taking advantage of beneficial features and of rejecting valueless measures from our therapeutic armamentarium. So far as concerns otology, our classic methods of treatment have left room for improvement. I will endeavor to show to what extent physical medicine has contributed to their enhancement.

THE GALVANIC CURRENT.

The galvanic current is too well known from its usefulness in the diagnostics of labyrinthine disease to need special introduction. Its therapeutic properties are not widely employed partly because galvanotherapy is associated with complicated and expensive apparatus. As a matter of fact any simple battery of dry or wet cells is all that is required, provided one adds a milliamperemeter to measure the intensity of the current.

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Galvanotherapy has been advocated for various aural diseases, but sufficient evidence is not available to place it on a sound scientific basis. When, however, the current is used in the procedure known as ionization,[1] it seems to possess some value in selected cases of aural sepsis. Friel,[2] and his English colleagues reported their successes with so-called zinc ionization in chronic otorrhea. For several years many American otologists[3] agreed that the procedure was a definite therapeutic advance. Lierle,[4] on the other hand, recently attempted to demonstrate the fallacy of this concept. It is questionable whether Lierle's finding will be accepted as final in the face of many authoritative favorable clinical reports.

In my own experience with zinc ionization in chronic suppurative otitis media during more than 10 years, I have come to the conclusion that the method is of value in definitely indicated cases, provided that it is correctly applied. Unless the zinc solution is conveyed to the middle ear, the treatment will fail. Obviously when complicating pathologic processes are present, zinc ionization or any other conservative procedure is useless. In the simple types of middle ear suppuration, especially in children, zinc ionization, in my hands, has produced favorable results in about 30 per cent of the cases. The technique must be carefully carried out and caution exercised in using a current strength which will not produce symptoms of vertigo. This is usually under 3 milliamperes.

The value of zinc ionization in clearing up the suppurating discharge following mastoidectomy[5] has been substantiated by many clinicians. Successful results have also been observed by Cottle[6] in persistently suppurating postoperative fistulae for which our usual methods have been inadequate.

On the other hand, failures in indicated cases have been reported, especially by otologists who have tried the method for the first time. In most such instances, inquiry has shown that the zinc solution was not of the correct formula. It is neither necessary nor conducive to the best results to use a zinc solution of greater strength than that advocated by Friel, namely one-fourth of 1 per cent.

The status of zinc ionization in otology is properly defined in the conclusions of Jobson[7]: *1.* Zinc ionization will cure any case of chronic otorrhea which is curable by drops; *2.* it

will accomplish this in a much smaller space of time; *3.* it will cure a large number of ears which do not respond to ordinary antiseptic treatment.

INFRARED AND LUMININOUS RAYS.

For the uses of infrared and luminous ray-therapy in otology, one must of necessity first assume that heat as a therapeutic agent possesses value. Heat has long been recognized as a helpful remedy in general inflammation. Clinical experience has taught us that it likewise possesses merit in the acute infections involving the ear. The probability of a chemical change in the tissues should also be entertained, as was pointed out by me[8] in an earlier study. Bierman[9] believes, however, that the preponderant effect is due to heat from which the most obvious bioreactions arise. Heat for therapeutic purposes is best obtained from the infrared generator or a luminous ray lamp.

For the acute catarrhal or suppurative types of otitis media, regardless of what local or general medication one may prefer, infrared radiation greatly increases the relief afforded the patient. Duration and frequency of the individual treatments vary with the status of the patient, *i. e.*, whether he is ambulatory or hospitalized. Satisfactory results follow prolonged radiation at frequent intervals.

There should be no misunderstanding concerning the use of infrared energy as an aid in acute otitis media. No specialist should attempt to substitute such treatment when the otoscopic picture definitely indicates the need of surgical interference, for infrared is just as valuable after incision of the drum as before. Adequately maintained drainage and prompt healing are common observations, apart from the analgesic properties which that energy possesses. Certain overenthusiastic claims that infrared therapy minimizes the incidence of mastoiditis should of course be rejected as lacking in scientific evidence.

Another indication for which infrared has proved beneficial is furunculosis of the auditory canal. Here, too, prolonged and frequent radiations serve to relieve pain, promote drainage and to insure prompt resolution. When moist heat appears

to be preferable, the lamp can be utilized to provide a constant, uniform and tolerant heating of the usual large compresses.

ULTRAVIOLET RAY THERAPY.

The scientific status of ultraviolet therapy in otology is fairly well established. There is some virtue in ultraviolet for certain selected cases of chronic otorrhea which fail to yield to other measures. In such cases quartz pencil applicators should be used to convey the rays through the auditory canal to the middle ear, if the opening in the drum is large, or if the drum is absent. If accessibility is difficult the instillation of a very weak eosin solution into the middle ear is indicated, to be followed by carrying the rays to the farthest point by suitable quartz rod applicators. The dye will carry the irradiation to the area of its reach.

Cemach[10], in discussing the treatment of the middle ear with ultraviolet stated: "Very often chronic suppurations dry up when treated endoaurally with the quartz pencil, after having remained refractory to all other forms of treatment. The processes are mostly in the central section of the tympanic cavity, with large defects of the tympanum through which the rays can penetrate, and the previous secretion can be diminished or reduced by medicinal measures."

There is only one process in the middle ear for which light therapy is virtually a specific—*tuberculosis*. As I have found that this affection reacts equally well to all forms of ultraviolet light, I regard this treatment as most effective. Combined with dietetic and supportive measures, Cemach was able to cure 56 out of a series of 64 cases. It should be noted that supplementary general ultraviolet radiation is an important part of the treatment of tuberculous foci, the results largely depending on combined local and general therapy. In this connection, however, the contraindications to general light radiation must be borne in mind, especially with coexisting febrile pulmonary lesions.

Resolution of protracted healing of mastoid wounds[5] can be hastened by local and general ultraviolet radiation. In the more severe cases the open method of treatment is employed. This permits frequent and prolonged infrared applications

which are followed at the end of the day by a mild suberythema dose of ultraviolet.

Many skin affections of the auricle theoretically present indications for ultraviolet treatment, but only a few have been found actually to be benefited by it. Chronic meatal dermatitis which sometimes persists after cessation of the aural discharge usually responds to one to three treatments. Obstinate cases of chronic eczema which fail to yield to ordinary measures and even to X-ray clear up under ultraviolet radiation. Huldschinsky[11] found that silver therapy in combination with quartz lamp irradiation was effective in the treatment of eczematous areas, either left to dry, or, while still moist, exposed to the quartz lamp at a close distance. During this irradiation the application may be repeated. The treatment is continued, until the applied silver solution becomes black, which usually requires from one to five minutes. The effects of the treatment appear immediately. Weeping eczema becomes dry, the formerly reddish areas appearing black and shiny and the itching decreasing.

Lupus of the auricle has been cured by local and general irradiation.[12] In erysipelas of the auricle and neighboring parts, ultraviolet stands out as a definite therapeutic advance. The experimental and clinical investigations of Ude,[13] Titus[14] and other workers coincide with my own experiences which have demonstrated not only the promptness but the superiority of this type of treatment over the older, uncertain methods.

DIATHERMY.

Diathermy has been earnestly experimented with in otologic affections because from a theoretical standpoint it held out hope of therapeutic effectiveness. There is, however, no evidence available to prove that diathermy is of any value in otosclerosis or in nerve deafness. There is even some question about its value in middle ear deafness other than the serous types. Intensive clinical experimentation justifies acceptance of the positive influence of diathermy only in so-called tubotympanic catarrhs. Available data[15] have demonstrated that the only effective way to adminster diathermy to the auditory mechanism is by placing the active eletrode over the mastoid

region of the affected ear and the indifferent electrode over the malar region of the opposite side of the face.

Animal experiments[16] to determine the deep effects of diathermy about the temporal bone and the comparative efficiency of two methods of administration, namely, by way of the auditory canals and by way of the mastoid region, led to the following definite conclusions:

1. Diathermy introduced by way of the ear canals does not reach the middle and inner ears with adequate intensity.

2. Diathermy introduced by an active electrode behind the external ear, with the indifferent electrode anterior to the ear on the opposite side, produces a substantial rise in temperature from the middle ear to the inner surface of the skull.

3. The maximum temperature is reached only after about 10 minutes application.

4. With d'Arsonval currents of 300 to 500 milliamperes, there is practically no effect on the brain or on the body temperature.

5. The highest temperature obtained was between the muscle and bone, where the increase was usually greatest.

6. In living tissue there is a return to normal temperature within 20 minutes; in dead tissue the transformation is much more gradual (up to 2 hours).

7. Under identical conditions, a d'Arsonval current produces higher temperatures in dead than in living tissues.

So-called radiathermy, or ultrashort wave therapy, has been available too brief a time to determine its influence on the auditory mechanism, and any opinion regarding the applicability of this advanced heat-generating agent must be withheld until exact experiments and clinical observations can be subjected to critical analysis.

Surgical diathermy, though in reality a purely surgical rather than a physical agent, is mentioned here because of its great interest to progressive otologists. The indications which frequently present themselves for electrosurgery are benign and malignant lesions of the auricle. Large keloids of the lobule, extensive lupus involvements, benign ulcerations

and malignant growths are very satisfactorily managed either by electrosurgical excision or by electrocoagulation. In cases in which radical removal of the auricle is essential, the cutting current, followed by electrocoagulation, has proved a powerful weapon in preventing malignant reinvasion. It may appear superfluous to many, but at present it is not amiss to point out, that for certain conditions electrosurgery possesses a number of advantages over classic surgery, and these advantages apply to otologic as well as to general surgery.

GENERAL COMMENT.

When one considers the unscientific manner in which physical therapy has been treated in the past, some of its advances are obvious and noteworthy. Its failures in otology are due primarily to a lack of training and experience. Nor should treatment be left to the technician, unless the otologist masters and supervises correct technical application. The tendency of referring incurable cases to the physical therapy department is hardly a just practice. Likewise, dependence on physical medicine for psychological effects, without proper justification, is unworthy of scientific otologists.

It is scarcely necessary to point out, that with the present imperfect status of physical therapy in otology, further research should be encouraged. As each day passes improved apparatus become available, and with improved facilities at our command, advances in our field become reasonably probable.

The requirements for an unhindered progress in this newer branch of therapeutics can be outlined in two brief statements:

1. Openmindedness on the part of the medical profession in general and the otolaryngologist in particular.

2. Encouragement of the pursuit of problems in physical therapy on a basis equal with that of all other problems in otology.

CONCLUSIONS.

1. Physical therapy should not be heralded as a cure-all in otology but rather as an aid to methods which for many diseases have been inadequate.

2. The chief value which the galvanic current offers in ear treatment is in ionization of selected cases of chronic otorrhea.

3. Infrared radiation is of definite benefit in acute inflammations and infections of the external and the middle ear.

4. Ultraviolet rays are reliably employed in otologic practice for middle ear tuberculosis and for eczemas, lupus and erysipelas of the external ear.

5. Diathermy in otology is still a controversial problem, but experimental studies have established a correct technical application of this agent which should be utilized for further investigation.

6. Recent scientific work has to a large extent removed physical therapy from empiricism to a state of rationale.

7. Physical methods while not revolutionary in otology have, nevertheless, added to our therapeutic knowledge and effectiveness and merit openmindedness and impartial consideration by every progressive member of our specialty.

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30 N. Michigan Avenue.

PHYSIOLOGICAL BASIS OF PHYSICAL MEASURES IN OTOLARYNGOLOGY.*

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Physical measures in otolaryngology are undergoing a scrutinizing process by the conservative part of the medical profession. Infrared and ultraviolet radiation, medical and surgical diathermy, galvanic ionization all have proved through their surviving an ordeal of empirical and commercial exploitation that there must be some virtue in their employment. Before any therapeutic measure is finally accepted clinicians demand not only a proof of success obtained under controlled observation but also a rational explanation of the mode of action of this measure in order to be able to determine its possibilities as well as its limitations.

It is axiomatic in present day physical medicine that no measure should be employed therapeutically which cannot be explained physiologically. Every physical measure exerts a primary physical effect and all physiological effects are secondary to the extent of this primary effect. A clear understanding of the primary physical effect is just as important from the standpoint of technique and clinical results as that of the secondary physiological changes. A great deal of the confusion that has existed in the past and may still exist is due to disregarding this obvious prerequisite.

Physical measures employed in otolaryngology may be conveniently classified regarding their primary physical effect into three groups.

1. Measures exerting a primary thermal effect; *2.* Measures exerting a photochemical effect; *3.* Measures exerting an electrochemical effect. Roentgen ray radiation according to a well justified routine is not considered to belong within the scope of physical therapy as generally practiced.

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1. Thermal Measures: The large range of physical measures exerting a primary *heat effect* is shown in the accompanying table. Their two main forms are radiant heating and diathermy; short wave diathermy is now being added to these two well established measures.

TABLE I.

SOURCES OF HEAT IN TREATMENT.

Source	Form of Energy	Heat transmitted
Hot water bottle	Long infrared rays (nonpenetrating)	By conduction
Hot compress		By conduction
Hot water bath		By conduction
Hot air bath		By convection
Steam bath		By convection
Electric heating pad	Long infrared rays (nonpenetrating)	By conduction and radiation
Infrared generator	Long and short infrared rays (penetrating)	By radiation
Incandescent light bulb (heat lamp)	Visible rays Short infrared rays (penetrating)	By radiation
Carbon arc lamp Sun	Short infrared rays Visible rays Ultraviolet rays	By radiation
Diathermy apparatus	High frequency oscillations (300 m. wave)	By electric oscillations
Short wave apparatus	Short radio waves (3 to 30 m.)	By electric oscillations

All of the physiological effects of thermal measures are brought about by the endeavor of the heat regulating mechanism to maintain a constant temperature in the body. When heat is applied to a part from any external source, the vasomotor mechanism in its effort to dissipate the excess heat, responds with an active vasodilation of the capillaries and subsequent increase of arterial and venous circulation. There appears to be an inherent tone in the capillaries which causes vasoconstriction. Lewis[1] has shown that irritation of the tissues by the application of heat produces a release of vasodilator substance — histamin — which in turn results in the dilatation of the capillaries. Upon the absorption of the vasodilator substance a greater proportion of the capillaries

becomes active instead of the few which carry blood under normal conditions; as a result a greater blood supply to the part occurs. This local hyperemia in turn brings about an increase of local nutrition, increase of the rate of removal of local tissue products and stimulation of the local resistive forces against infection. According to the temperature law of Van't Hoff for every rise of 10° C. the rate of oxidation is increased 2.5 times and hence an increase of even fractions of a degree will enhance tissue metabolism to a marked extent.

A sedative effect on the neuromuscular system is the second important local effect of heat application. It results in lessening of nerve sensibility or relief of pain when mild heating is employed. The mechanism of sedation may be explained by the desensitization of superficial sensory nerves due to heat. Strong superficial heat stimuli exert marked pain.

a. Radiant Heating: Within a few minutes after exposure to radiant heating the skin becomes red and feels hot; there is no latent period as with ultraviolet radiation. Maximum tolerance surface temperatures under radiant heating have been determined as follows.

TABLE II.

MAXIMUM TOLERANCE SURFACE TEMPERATURES UNDER RADIANT HEATING (SONNE).

Radiation	Surface Temperature	Undersurface Temperature
Short infrared and visible	110.8° F.	117.8° F.
Long infrared	113.9° F.	107.0° F.

This table shows that infrared generators emitting a preponderance of visible and near infrared radiation warm the depth of the skin more, while those emitting a preponderance of long infrared exert their maximum heating effects on the surface. In general clinical practice the first type of generators prevail.

A comparison between the physics and physiological effects of infrared and ultraviolet radiation is shown in Table III.

TABLE III.

COMPARISON OF INFRARED AND ULTRAVIOLET RADIATION. ([3])

Radiation	Infrared		Ultraviolet	
	Long	Short	Long	Short
Wavelengths	120,000 to 15,000 A°	15,000 to 7,000 A°	4,000 to 2,900 A°	2,900 to 1,800 A°
Penetration	.1 to 3 mm.	10 to 30 mm.	.3 to .5 mm.	1. to .3 mm.
Erythema: Development	Immediately		After hours	
Erythema: Appearance	Darker red, spots or network		Lighter red, sharply bordered	
Erythema: Duration	Less than one hour		Hours and days	
Pigmentation	Mottled		Homogeneous (tanning)	
Tolerance	Develops occasionally		Increases constantly	

Heat radiation on account of its comparative simplicity and safety of application is much preferable to diathermy in many conditions when efficient heating of not too deeply situated structures is desirable. The above table shows that short infrared penetrates to a depth of 10 to 30 mm., thus affecting the entire thickness of the skin, part of the subcutaneous tissue, superficial strata of muscles, and accessibly located tendons and bones. Many unnecessary burns and other mishaps in recent years could have been prevented, had neophytes in physical therapy abstained from applying diathermy without rhyme or reason for many of the conditions where infrared radiation would have proved just as effective or even more so with a minimum of risk.

b. Diathermy as well understood by this time, signifies heating by a conversion of the energy of a high frequency current. It has been conclusively proven that this heating always occurs from without inward, and is therefore greatest near the electrodes. The distribution of heating along the path of the diathermy current varies in accordance with the resistance of the tissues and their grouping. An electrical current prefers the shortest path and that of least resistance and for this reason in the usual application of diathermy through a cross section of the body in an extremity or the chest, more of the current will travel along the less resistant soft tissues, and there will be more heat effect upon these.

Bony and cartilaginous structures will heat up in preference to soft structures when they extend in parallel to the plates and there is a long path of low resistance between them. Such is the case when a plate electrode is placed along the forehead and another under the nape of the neck.

There can be no doubt that for the heating of deep lying tissues diathermy is superior to external forms of heat application. In animal experiments the carpal joint of a horse which is similar to the knee joint in men, showed a rise of 4-5° C. in 15 to 25 minutes under diathermy; in the vitreous of the eye in dogs a rise of 6:98° C. has been effected; all this in the presence of the cooling effects of blood circulation, conduction and radiation.

The physiological effects of diathermic heating do not differ in principle from those produced by nonconversive sources; due to the more penetrating heating the sedative effect on neuromuscular mechanism seems more marked. Sensory nerve pain and muscular spasm due to motor nerve irritation are both relieved. What degree of heat effect is most desirable or most beneficial from the standpoint of physiological results is still undetermined. The regulation of the dosage of diathermy by comfortable toleration of the patient works perhaps as well as any other control we can apply.

The *Oudin current* is a form of monoterminal high frequency application; when applied through vacuum or non-vacuum electrodes to the skin or to the mucosa, it exerts superficial heating; the ozone and nitrous oxide generated by the sparking may exert a mild bactericidal effect in the superficial layers of the skin or mucosa.

c. Short wave diathermy is a recent development in high frequency therapy. It was first known in this country in the form of radiothermy or general heating of the body placed in a condenser field, charged by 30 m. oscillations from powerful radio tubes. It was found that these waves, named short diathermy waves in contrast to the 300 m. oscillations set up by the regular diathermy spark discharge, can be conveniently used for local heating, with approximately the same physiological effects as diathermy. The mode of heating is somewhat different because in addition to conductive heating there is "dielectric" heating by electromagnetic

effects on tissue molecules. As a result there is more uniform heating of all tissues. At a wavelength of about 12 m. backed up by sufficient power, even heating in all tissues regardless of their electrical conductivity is claimed.

Ultrashort wave diathermy signifies the use of still shorter 3 to 10 m. oscillations set up by powerful tube apparatus; it is claimed that these exert a selective bactericidal action and can be safely employed for nondraining suppurative processes in which ordinary diathermy is strictly contraindicated.

At present there exists no standard of comparison between the many forms of short wave apparatus with which the market is being flooded. The extent to which deep heat production is desirable and safe needs controlled clinical and experimental clarification.

2. Photochemical Measures: The present status of ultraviolet radiation from the physical and physiological standpoint is a much involved problem and no attempt will be made for even a brief review of it. When Finsen first cured lupus with a carbon arc lamp, in which heat rays were filtered out by running water, he thought that the ultraviolet rays act as a bactericide; now we are of the opinion that the curative effect is rather due to a stimulation of the tissues in the form of a profound inflammatory reaction. Direct bactericidal action of light can be exercised only in infections located strictly on the surface. With one or two exceptions artificial sources of ultraviolet energy emit only a minimal amount of radiation in the bactericidal range.

The principal stimulative effects of ultraviolet on the skin are manifested by dermatitis, pigmentation and activation of cholesterol; those on the general organism are manifested by changes in the blood and metabolism. Both groups of effects have been well studied; the mechanism of the action of ultraviolet on mucous membranes, however, is not well comprehended and there is not adequate theoretical explanation available of the undoubted clinical results observed in acute and chronic inflammatory processes. The fact that in the treatment of such seemingly local condition as tuberculosis of the larynx many of the clinicians emphasize the benefit of general body irradiations in preference to those locally applied as worth noting.

3. Electrochemical Measures: The measures exerting electrochemical effects are typified by the galvanic current, in the form of iontophoresis or the driving in of ions into the tissues by the polarity action of the current. As well understood, the positive pole of a galvanic current repels ions with a positive charge — such as those of heavy metals, zinc and copper — while the negative pole of the current repels ions with a negative charge such as chlorine. When medicinal solutions containing these heavy metals are applied by ionization, these metals on account of their great affinity to the tissue proteins form an insoluble precipitate with them. As a result there is devitalization of tissue — a widespread form of chemical cauterization — in proportion to the strength and length of current flow. The thin or heavy slough leads to a slow separation of detritus and formation of new granulation tissue. There may be by reflex or by direct destruction of nerve endings, some sedation of sensory nerve irritation originating in the mucosa. This may serve as a physiological basis of the explanation of a treatment recently recommended for allergic conditions by a form of zinc ionization of the nasal mucosa.

All of the enumerated physiological effects of the three principal groups of physical agents border on destructive effects, if these measures are employed in excessive strength, duration or in a subject with special sensitivity. We must emphasize over and over again that any physical agent which is powerful enough to cause physiological effects can cause deleterious effects as well. Statements such as that a certain type of lamp or a certain form of current cannot burn are utter delusions. Physical therapy offers many invaluable measures, but is also a source of potential danger. Hence no thoughtful physician will attempt to employ physical measures without adequate knowledge of their mode of action and without actual clinical instruction and experience in the proper technique of application.

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BOOK REVIEW.

Sculpture in the Living. Rebuilding the Face and Form by Plastic Surgery. By Jacques W. Maliniak, M.D., Formerly Major, Reconstructive Hospitals, Allied Armies; Attending Plastic and Reconstructive Surgeon at Sydenham Hospital, New York City; St. Petersburg Hospital, New Brunswick, N. J.; Beth Israel Hospital, Newark, N. J., etc., with a Foreword by the late Wendell C. Phillips, M.D., Former President, American Medical Association. 203 pp. with 70 illustrations. New York: Romaine Pierson, Inc., 99 Nassau street. Cloth price $3.00, 1934.

This book is concerned more with the nature and scope of plastic surgery with emphasis on the social and esthetic aspects of deformities rather than technique of repair. A brief history of the development of plastic surgery is given and each chapter begins with a description of the anatomy and physiology of the part to be considered. The field of plastic surgery is a broad one, and it would be impossible to cover it thoroughly in a book of this size; however, most of the more important considerations are discussed briefly. It is written in a style that should be understandable and interesting to the layman as well as to the physician and should acquaint both with some of the possibilities as well as the limitations of plastic surgery. The final chapter discusses the legal and illegal aspects of plastic surgery, which is of extreme importance in connection with this type of work. The book is illustrated with unretouched photographs taken from the personal practice of the author and supplemented by diagrams in some instances to show a point of technique. Another admirable feature of this book is that it endeavors to raise the specialty of plastic surgery above its all too common association with quackery and cosmeticians.

W. G. H.

AMERICAN OTOLOGICAL SOCIETY, INC.

The Sixty-Eighth Annual Meeting of the American Otological Society was held under the presidency of Dr. Samuel J. Crowe of Baltimore, at the Royal York Hotel, Toronto, Ontario, May 27, 28, 29, 1935. In point of attendance and in the uniform excellency of the papers presented as well as the manifest interest taken in them by those present, the meeting was regarded by many as the high water mark in the history of the Society. Toronto proved a delightful place to meet, made especially so by the solicitude shown by the Toronto Otolaryngologists and their wives for the entertainment of the Society.

Upon recommendation of the Council, Dr. Page Northington of New York City and Dr. Dean M. Lierle of Iowa City, Iowa, were elected Active Members and Dr. Albert Gray of London, England, was elected an Honorary Member. Dr. Francis Packard, Dr. Edmund P. Fowler, Dr. Thomas J. Harris, Dr. Samuel J. Crowe, Dr. Isidore Friesner, Dr. John R. Page and Dr. Perry Goldsmith were elected members of the Council for 1935-36.

The Council elected as officers for the ensuing year: Dr. Francis R. Packard, President; Dr. Edmund P. Fowler, Vice-President; Dr. Thomas J. Harris, Secretary-Treasurer.

The Committee on the Study of Otosclerosis presented a report of its activities during the past year. The New York Committee on the Investigation of Otitic Meningitis made a report of equal interest.

The plan of holding the meetings of the five national Societies in the same place and following one another met with general approval.

The members of the Society are urged to fill out and return to the Secretary the Biographical Questionnaire sent them some time ago. The Secretary will be glad to supply another blank in case the original has been mislaid.